Appendix B

ISA Review Team Questions

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Appendix B

ISA Review Team Questions

Question # 1 **Status** Acceptable

Cited Submittal Text

"4.7.2.2.5 Mitigating Design Features. With the ventilation system operating, and the release from the spill carried out through the stack, atmospheric dispersion is significantly greater so that exposure to the public receptor and the co-located worker are proportionately reduced. If release is elevated 88m, exposure to the public receptor is reduced to 1.49 x 10-3 Sv, or 0.15 rem.

If release through cell and building ventilation systems to the stack is the method chosen to mitigate the consequences of the HLW receipt tank break, the features of the ventilation system that assure routing the release to the stack are Design Class II features."

"4.8.1.1 Design Class I Engineered Features. For the HLW/LAW option, failure of the HLW receipt tanks during a DBE challenges the public exposure standard of Table 4-27 as discussed in Section 4.7.2.10, "Design Basis Earthquake." As such, the HLW receipt tanks are designated as Design Class I."

Cited Reference

TWRS-P Project Initial Safety Analysis Report BNFL-5193-ISAR-01, Rev. 0, Section 4.
Technical Report, BNFL-5193-TR-01

Evaluation Criteria

Section 3.3.2 of DOE/RL-96-0003 (item 3, page 6): The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled. Item 6 requires that the adequacy of the categorization of systems, structures, and components that are important to safety be identified.

Section 4.1.1 of DOE/RL-96-0006 states that to compensate for potential human and mechanical failures, a defense-in-depth strategy should be applied to the facility commensurate with the hazards such that assured safety is vested in multiple, independent safety provisions, no one of which is to be relied upon excessively to protect the public, the workers, or the environment. This strategy should be applied to the design and operation of the facility.

RL/REG-97-11, Revision 1, Section 6.5 - Analysis of Design Basis Events
RL/REG-97-11, Revision 1, Section 6.6 - Adequacy of SSC Categories

Discussion

The attributes required for DC I and DC II SSCs vary from system to system depending on the individual safety function of the system and the expected performance during accidents. DOE Order 420.1, among others, requires multiple barriers to mitigate radioactive releases and demonstrate defense in depth in the design of the facility. Defense in depth is also one of the top-level requirements identified for this plant. The ISA did not show that two confinement barriers are planned that remain intact for the range of possible events, including a seismic event, without compromising HVAC and other system functions. Table 4-47 lists the Design Class II systems and elaborates on the ventilation system. The table describes the Design Class II systems, but excludes the HEPA filters by stating that the "C5 extract system (including the ductwork, stack, and fans but not the filters)". Thus, this table explains that the HEPA filters in the C5 extract system are not Design Class II. Presumably this implies that they are not Design Class I either and that they are neither quality level QL-1 nor QL-2.

Also, the guiding philosophy to radionuclide release mitigation should be to minimize the release from the facility. This approach is not used in the BNFL design, which relies on the HVAC system (classified as DC II except for the filters) to conduct the release to the stack. This approach does reduce the ground level concentration due to the elevated release through the stack and hence the dose, but does not reduce the amount of radionuclides released.

Design Classification of process and other buildings have not been discussed in the ISAR. The function and structural design concepts of the buildings and their internal structures in mitigating the consequences of various accidents have not been discussed at all.

Buildings provide an important confinement system and taken in conjunction with other primary confinement system provide redundant barriers to ensure defense in depth in the design of the facility. The design criteria applied to these barriers are critical in ensuring that they will perform their intended function. The ISA did not show that two confinement barriers were contemplated in the design, nor did it discuss or justify the design classifications/criteria to be applied.

The Top-Level Safety Standards and Principles define defense in depth as the fundamental principle underlying the safety technology of the facility centered on several levels of protection including successive barriers preventing the release of radioactive materials to the workplace or environment.

Human aspects of defense in depth are considered to protect the integrity of the barriers, such as quality assurance, administrative controls, safety reviews, operating limits, personnel qualifications and training, and safety programs. Design provisions, including both those for normal facility systems and those for systems important to safety help to:
1) prevent undue challenges to the integrity of the physical barriers; 2) prevent failure of a barrier if it is challenged: 3) where it exists, prevent consequential damage to multiple barriers in series; and 4) mitigate the consequences of accidents. Defense in depth helps to ensure that two basic

Description

In the referenced accident scenario, explain how defense in depth will be achieved for the HLW receipt tank spill accident (or any accident scenario), considering the multiple barrier aspect of the contractual definition of the terms above. Is the HLW receipt tank considered the first line of defense and the receipt cell the second line of defense? Since the HLW receipt tank is not categorized for this accident, is it to be considered as Design Class I, Design Class II, or defense in depth? Also, justify the design classification of the HVAC filters in the TWRS-P facility.

There needs to be a documented, systematic and comprehensive approach to defense in depth. What is BNFL's philosophy and criteria with regard to design class and defense in depth? BNFL's philosophy, as well as criteria, needs to be discussed in the ISAR. This should include but not limited to the following:

· Discuss and provide information on the confinement design concepts including number and arrangement of confinement barriers and their required characteristics.
· Discuss the role of how the process building structure and internals will play in such a confinement scheme and in housing systems and components required to mitigate accidents.
· Discuss and provide justification for the design classification of various buildings and their internal structures in view of their confinement and accident mitigation function. Discuss how this design classification and the use of corresponding codes and standards will provide the confinement and the accident mitigation functions.
· In a meeting on January 28, 1998, BNFL presented a scheme for separating the design classification from the natural phenomena hazard mitigation classification for various SSCs. Please discuss and provide information listing the design classification, NPH classification and quality levels.
· How the requirement for defense in depth (safety technology) is met by BNFL in the facility design.

Contractor Response

The responses below first address the five specific items listed at the end of the description section of the DOE Question, and then discuss the cited example of the HLW receipt tank spill. See Appendix A to the ISAR for further discussions on each of the items and definitions of terms such as important-to-safety and Safety Design Class.

CONFINEMENT DESIGN CONCEPTS.

There are three confinement barriers specified in the design wherever significant quantities of radioactive material are present. These are: (1) the vessel and piping with the associated vessel ventilation system, (2) the cell containing the vessel and piping with the associated cell ventilation system, and (3) the operating area outside the cell with the associated operating area ventilation system.

Initial (i.e., baseline) barrier design is a conservative approach based on the requirements in BNFL engineering design standards. As an example, standard ventilation system design provides a high degree of redundancy, using multiple filter banks in parallel with a second complete set in series. Further (post-baseline) barrier design, quality assurance, and operational requirements may then arise in Part B as a result of defense-in-depth evaluations, identification of important-to-safety items, and the classification of SSCs as Safety Design Class.

PROCESS BUILDING STRUCTURE

The process building and its internal structures have no Safety Design Class functions but portions are important-to-safety items.

The process building and its internal structures have no Safety Design Class functions because the prevention/mitigation of accidents that challenge accident exposure standards is achieved through the integrity of the primary barrier (process vessels) and/or the cell ventilation system.

Portions of the process building internal structure are important-to-safety (but not Safety Design Class) because they are Seismic II/I items, that is, their failure under DBE conditions could prevent Safety Design Class items from performing their specified safety function.

BUILDING DESIGN CLASSIFICATION AND CORRESPONDING CODES

Based on the bounding accident analyses presented in Section 4.7 of the ISAR, no building structures have been identified to date as Safety Design Class. Portions of the process building structure have been identified as important-to-safety and will be designed to the appropriate codes and standards identified in the SRD for such items.

No other structures have been identified at this time as being important-to-safety. They will be designed to UBC requirements unless further accident evaluations in Part B identify them as Safety Design Class.

DESIGN CLASSIFICATION VS. NATURAL PHENOMENA HAZARD MITIGATION

BNFL's design classification process identifies those SSCs that are required to prevent or mitigate accidents that could exceed public or worker exposure standards as Safety Design Class. The natural phenomena hazard criteria are then applied to those Safety Design Class SSCs commensurate with their need to perform a safety function associated with the natural phenomena hazard.

The following examples illustrate the criteria used to determine which natural phenomena hazards criteria are applied as a result of the design classification process:

· If accident analyses designate a vessel as Safety Design Class because it needs to contain its contents during and after a DBE to prevent accident exposure standards from being exceeded, the vessel is designated Seismic Category I and is designed to the loads specified for the DBE in Table 4-1 of the SRD.

· If accident analyses designate an interlock as Safety Design Class because it needs to function during normal operation to preclude overexposure to workers, but does not need to function during and after a DBE, the interlock is designated Seismic Category III and is designed to the loads specified for the UBC earthquake in Table 4-2 of the SRD.

· Similarly, if an SSC is designated as important-to-safety (but not Safety Design Class), it is designed to Table 4-1 loads if its important-to-safety function is required during the earthquake, and to Table 4-2 loads if it is not.

DEFENSE-IN-DEPTH

This topic is discussed in detail in Section 4.1 of Appendix A to the ISAR.

HLW RECEIPT TANK SPILL

The HLW receipt tank spill presents a potential challenge to both public and worker accident exposure standards. The response below addresses only specific issues associated with the spill. See Section 8.0 of Appendix A to the ISAR for a more complete discussion of the BNFL safety approach related to this event.

Confinement Barriers. The following confinement barriers are present in the design and were identified prior to any accident analysis. These barriers are based on the treatment processes identified in the BNFL TWRS-P Basis of Design, and BNFL's experience designing and operating facilities that treat similar waste:

· The highly radioactive material is contained in three high integrity stainless steel tanks designed to appropriate BNFL design standards
· The tanks are vented by the process vessel vent system, which incorporates a high degree of redundancy and is designed to appropriate BNFL design standards
· The tanks are located in a cell with thick concrete walls designed to appropriate BNFL design standards with shielding thicknesses based on conservative source terms and meeting ALARA design objectives
· The cell is exhausted by the C5 Extract system, which incorporates a high degree of redundancy and is designed to appropriate BNFL design standards

· There is an operating area outside the cell at a positive pressure with respect to the cell and provided with suitable radiation and airborne monitoring systems designed to appropriate BNFL design standards
· The operating area is exhausted by the C3 Extract system, which also includes redundancy and is designed to appropriate BNFL design standards.

Potential Accidents. There are two situations to be considered: spills induced as a result of an earthquake and spills from all other causes (e.g., overflows, tank leakage). Features for the prevention/mitigation of these two cases are discussed below.

Earthquake Induced Spill. An earthquake could credibly cause all three HLW receipt tanks to fail. The preliminary accident analysis in Section 4.7 of the ISAR shows that both public and worker accident exposure standards could be exceeded. Consequently, all three tanks are designated as Safety Design Class and Seismic Category I. The cell structure is designated as important-to-safety (but not Safety Design Class) and Seismic Category II (i.e., Seismic II/I) because its catastrophic failure during an earthquake would cause the tanks to fail, thereby preventing them from performing their safety function. Operation (or failure) of the process vessel vent and/or the cell ventilation is not required to ensure that the specified safety function could be performed. It should be noted that the BNFL approach to protection against an earthquake is to ensure that one level of engineered, passive protection (i.e., the Safety Design Class, Seismic Category I tanks) can be demonstrated to survive the event intact. This is discussed in more detail in Section 8.4 of Appendix A to the ISAR.

Other Spills. Except for an earthquake, no mechanism was identified that could credibly cause more than one HLW receipt tank to fail. For this case, complete failure of a single tank was chosen to envelope the entire family of potential spills. The preliminary accident analysis in Section 4.7 of the ISAR shows that only worker accident exposure standards could be exceeded. To mitigate the event, the C5 Extract is designated as Safety Design Class; however, since there is no earthquake "involved," the system was designated Seismic Category III. Again, operation (or failure) of the process vessel vent is not required to ensure that the specified safety function could be performed. Other important-to-safety items (such as high level alarms) may ultimately be specified in Part B when the design has evolved sufficiently to identify such items.

Summary. Three sets of high integrity barriers have been specified - independent of any accident analysis - to confine material contained in the HLW receipt tanks. In addition, the following items are classified as a result of possible accidents:

SSC	Classification	NPH Design
HLW receipt tanks	Safety Design Class	Seismic Category I
Cell structure	Important-to-Safety	Seismic Category II
C5 Extract system	Safety Design Class	Seismic Category III

Disposition

The BNFL response is acceptable.

HLW RECEIPT TANK SPILL

The HLW receipt tank spill presents a potential challenge to both public and worker accident exposure standards. The response below addresses only specific issues associated with the spill. See Section 8.0 of Appendix A to the ISAR for a more complete discussion of the BNFL safety approach related to this event.

Confinement Barriers. The following confinement barriers are present in the design and were identified prior to any accident analysis. These barriers are based on the treatment processes identified in the BNFL TWRS-P Basis of Design, and BNFL's experience designing and operating facilities that treat similar waste:
· The highly radioactive material is contained in three high integrity stainless steel tanks designed to appropriate BNFL design standards
· The tanks are vented by the process vessel vent system, which incorporates a high degree of redundancy and is designed to appropriate BNFL design standards
· The tanks are located in a cell with thick concrete walls designed to appropriate BNFL design standards with shielding thicknesses based on conservative source terms and meeting ALARA design objectives
· The cell is exhausted by the C5 Extract system, which incorporates a high degree of redundancy and is designed to appropriate BNFL design standards
· There is an operating area outside the cell at a positive pressure with respect to the cell and provided with suitable radiation and airborne monitoring systems designed to appropriate BNFL design standards
· The operating area is exhausted by the C3 Extract system, which also includes redundancy and is designed to appropriate BNFL design standards.

Potential Accidents. There are two situations to be considered: spills induced as a result of an earthquake and spills from all other causes (e.g., overflows, tank leakage). Features for the prevention/mitigation of these two cases are discussed below.

Earthquake Induced Spill. An earthquake could credibly cause all three HLW receipt tanks to fail. The preliminary accident analysis in Section 4.7 of the ISAR shows that both public and worker accident exposure standards could be exceeded. Consequently, all three tanks are designated as Safety Design Class and Seismic Category I. The cell structure is designated as important-to-safety (but not Safety Design Class) and Seismic Category II (i.e., Seismic II/I) because its catastrophic failure during an earthquake would cause the tanks to fail, thereby preventing them from performing their safety function. Operation (or failure) of the process vessel vent and/or the cell ventilation is not required to ensure that the specified safety function could be performed. It should be noted that the BNFL approach to protection against an earthquake is to ensure that one level of engineered, passive protection (i.e., the Safety Design Class, Seismic Category I tanks) can be demonstrated to survive the event intact. This is discussed in more detail in Section 8.4 of Appendix A to the ISAR.

Other Spills. Except for an earthquake, no mechanism was identified that could credibly cause more than one HLW receipt tank to fail. For this case, complete failure of a single tank was chosen to envelope the entire family of potential spills. The preliminary accident analysis in Section 4.7 of the ISAR shows that only worker accident exposure standards could be exceeded. To mitigate the event, the C5 Extract is designated as Safety Design Class; however, since there is no earthquake "involved," the system was designated Seismic Category III. Again, operation (or failure) of the process vessel vent is not required to ensure that the specified safety function could be performed. Other important-to-safety items (such as high level alarms) may ultimately be specified in Part B when the design has evolved sufficiently to identify such items.

Summary. Three sets of high integrity barriers have been specified - independent of any accident analysis - to confine material contained in the HLW receipt tanks. In addition, the following items are classified as a result of possible accidents:

SSC	Classification	NPH Design
HLW receipt tanks	Safety Design Class	Seismic Category I
Cell structure	Important-to-Safety	Seismic Category II
C5 Extract system	Safety Design Class	Seismic Category III

Question # 11 **Status** Acceptable

Cited Submittal Text None.

Cited Reference ISAR, Table 3-4 Subject - Operations

Evaluation Criteria DOE/RL-96-0003, Regulatory Process, Section 3.3.2, Item 3, "The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled."

Discussion No records are listed for process sample results.

Description Why were sample results not listed in Table 3-4?

Contractor Response Samples are included in multiple entries in Table 3-4. Safety Management Records (e.g., Startup test results; Material balance, inventory, transfer, and disposal records; and Environmental release and monitoring records).

Disposition The BNFL response is acceptable but subject to the following:

The response dealt with the records associated with the use of the sample results, the question was meant to deal with the sample results themselves. This issue will be pursued during future interactions between the RU and BNFL.

Question # 12 **Status** Acceptable

Cited Submittal Text BNFL graph.

Cited Reference Technical Report, Section 5.2, next to last paragraph.

Evaluation Criteria DOE/RL-96-0003, Regulatory Process, Section 3.3.2, Item 3, "The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled."

Discussion There is no mention of any methods of process sampling penetrations and the attendant controls for isolation and shielding.

Description What are the isolation and shielding requirements for process samples, sampling equipment and penetrations to the process equipment?

Contractor Response The facility contains an extensive sampling system. The system uses both automatic and manual sampling stations that sample the process in enclosed cabinets located throughout the facility. Once samples are collected, the system pneumatically transfers the samples to the laboratory located on the 14 meter level.

Details regarding isolation and shielding of the sampling system will be further developed during Part B. Methods, controls, equipment, and worker protection will also be developed during Part B.

Disposition The BNFL response is acceptable but subject to the following:

The response committed to further details regarding sample system isolation and shielding during Part B as well as methods, controls, equipment and worker protection.

Question # 13 **Status** Acceptable

Cited Submittal Text None

Cited Reference ISAR Section 4.7.2, "Accidents"

Evaluation Criteria DOE/RL-96-0003, Regulatory Process, Section 3.3.2, Item 3, "The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled."

Discussion Selective power loss may permit the continued flow of feed to the melter in an accident. This could pressurize the off gas system if the ventilation system is also inoperable, causing release of radioactivity by steam entrainment. No interlocks are credited to prevent the flow of feed.

Description
1. Is this postulated scenario among the analyzed accidents?
2. If not, please evaluate.

Contractor Response The PHA addressed a loss of power event for the melters and offgas systems as event numbers 3200/173 (HAR p. 5-160) and 3200/255 (HAR p. 5-145). Neither postulated continued feed to the melter as an initiating event, but both address loss of fan supply resulting in steam discharge to the cell. Both of these fault schedule entries indicate that the offgas power supply system will have sufficient reliability to ensure supply. Other PHA events involving melter pressurization are 3200/167 (HAR p. 5-130) and 3200/193 (HAR p. 5-163). These latter two events are included in ISAR Table 4-28 as events 36 and 37 and were considered for further accident analysis.

Additionally, HAR Section 4.4.1 and ISAR Section 4.7.1.2.5 discuss the results of examining the DWPF and WVDP hazard and safety analysis for additional events. A potential steam explosion in the melter was analyzed as a bounding case for both facilities. As stated in ISAR Section 4.7.1.2.5, conditions for a melter steam explosion were deemed to be not credible for both facilities. However, the melter steam explosion scenario is retained as a candidate for a severe accident analysis for TWRS-P at a future design stage.

During the Detail design, HAZOPs are planned as a part of the PSAR development. The HAZOP for the melter feed and offgas systems will identify if interlocks need to control feed to the melter in case of power loss.

Disposition

The BNFL response is acceptable but subject to the following:

The response committed to HAZOPs as part of the PSAR for the melter feed and off gas system to identify if interlocks are needed to control feed to the melter in case of (selective) power loss.

Question # 14 **Status** Acceptable

Cited Submittal Text None

Cited Reference ISAR Section 4.2.1.1, 13th paragraph and Technical Report Section 5.2 next to last paragraph.

Evaluation Criteria DOE/RL-96-0003, Regulatory Process, Section 3.3.2, Item 3, "The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled."

Discussion There is no mention of the methods, controls and equipment needed to safely obtain samples from the process vessels and transport them to the analytical lab. There is also no mention of any methods of process sampling penetrations and the attendant controls for isolation and shielding. This is an important area of worker exposure control.

Description Describe the methods, controls and equipment needed to safely obtain and transport process samples to the laboratory.

Contractor Response The facility contains an extensive sampling system. The system uses both automatic and manual sampling stations that sample the process in enclosed cabinets located throughout the facility. Once collected, the system transfers the samples to the laboratory located on the 14 meter level. Detailed discussion with the RU on January 28, 1998 indicated no additional information was needed in this area.

Details regarding isolation and shielding of the sampling system will be further developed during Part B. Methods, controls, equipment, and worker protection will also be developed during Part B.

Disposition The BNFL response is acceptable .

Question # 15 **Status** Acceptable

Cited Submittal Text None

Cited Reference Technical Report, Section 3.4.3.1, last paragraph

Evaluation Criteria DOE/RL-96-0003, Regulatory Process, Section 3.3.2, Item 3, "The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled."

Discussion

Hydrogen chloride and hydrogen fluoride gasses are very corrosive. There is no mention of measures to inhibit or otherwise control corrosion down stream of the melter in the off gas stream and subsequent scrub streams. The quencher is stated to remove in excess of 90%. This leaves up to 10% that goes down stream.

Description

What, if any, measures are needed to control corrosion in the off gas stream downstream of the quencher?

Contractor Response

From ISAR Section 4.2.3.2. "Operability, Reliability, Availability, Maintainability and Inspectability." For SSCs required to perform a safety function, the facility design ensures reliability commensurate to the importance of that function, the ability to carry out required maintenance activities and that the most appropriate inspection regime is adopted. "

The specific measures that will be used to control corrosion in the off gas stream downstream of the quencher have not yet been selected. The primary method for corrosion protection is material selection. BNFL Inc. will develop maintenance and inspection regimes commensurate with the importance, the design lifetime, accessibility, and service conditions for structures, systems, and components at the facility.

Disposition

The BNFL response is acceptable .

Question # 16 **Status** Acceptable

Cited Submittal Text

None

Cited Reference

Technical Report, Section 3.2.5.2

Evaluation Criteria

DOE/RL-96-0003, Regulatory Process, Section 3.3.2, Item 3, "The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled."

Discussion

There is no mention of a water rinse between the residual feed purge using 0.5 M NaOH and the column elution using 0.5 M nitric. Without a water rinse, heating and gassing occur. This may result in resin or equipment failure, causing potential worker exposure, especially with the column being loaded.

Description

Why is there no water rinse between the loading and elution cycles?

Contractor Response

As stated in the Technical Report Section 3.2.5.2, the elution cycle for the Tc ion exchange column doesn't use a water rinse between the 0.5 M NaOH rinse solution and 0.5 M HNO3 eluate. Our experience in operating these types of systems shows a water rinse reduces process efficiency because the resin elutes with water. Water rinsing alone requires too many column volumes to elute the resin. There is no substantial dose contribution from the Tc inventory.

BNFL recognizes that the heat of hydration from the acid-base reaction could heat the column, but maintaining flow through it will minimize this effect. During Part B, BNFL will assess the impact of the elution scheme on the resin and evaluate the need for a water rinse.

Disposition

The BNFL response is acceptable but subject to the following:

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The response committed to an assessment of the resin elution scheme and an evaluation of the need for a water rinse during Part B.

Question # 17 **Status** Acceptable

Cited Submittal Text None

Cited Reference ISAR Section 7.2.1

Evaluation Criteria DOE/RL-96-0003, Regulatory Process, Section 3.3.2, Item 3, "The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled."

Discussion Two chemicals are cited as being highly hazardous, ammonia and nitric acid. There are requirements in this and subsequent sections for other hazardous chemicals, but these chemicals are not listed.

Description
1. Are all of the chemicals on the list considered hazardous?
2. If not, which ones are not and why would they be treated differently from a procedural, training, maintenance, configuration, etc. standpoint?

Contractor Response As stated in 7.0, the chemical safety program ensures that activities involving hazardous chemicals are conducted so that the safety and health of workers, the public, and the environment are protected. The list in 7.2.1 is identified as process chemicals that could be hazardous.

1. ISAR Section 7.2 provides a description of the Chemical Safety Program (CSP), which is one of several management controls for protection of facility workers and the public. The chemical inventory in Section 7.2.1 is a listing of chemicals expected to be used in the TWRS-P Facility process. Hazards associated with these chemicals were evaluated in the Hazard Analysis Report (See Table 4-3, Hazardous Characteristics of Process Chemicals and Potential By-Products).

From the listing in Section 7.2.1, only ammonia and nitric acid are considered to be Highly Hazardous because they could be present in amounts exceeding the threshold quantities listed in Appendix A to 10 CFR 1910.119. In addition, the projected quantities of ammonia and nitric acid could exceed the emergency planning and notification thresholds for Extremely Hazardous Substances in Appendix A of 40 CFR 355.

From a worker protection standpoint, all of the listed chemicals may be hazardous to human health under some circumstances. The CSP will help ensure the hazards to personnel are either avoided or minimized.

2. From the listing in Section 7.2.1, only ammonia and nitric acid are considered highly hazardous from a process safety management or public safety standpoint. As such, these two chemicals will be controlled in accordance with the established facility process safety requirements.

Again, from an occupational safety standpoint, all of the listed chemicals could be hazardous to facility personnel in an occupational setting. The CSP will help ensure the hazards to personnel are either avoided or minimized by requiring work (including maintenance) to be conducted by procedure, requiring evaluation and control of hazards, and specifying training and personal protection requirements.

Disposition The BNFL response is acceptable.

Question # 18 **Status** Acceptable

Cited Submittal Text "...dry chemicals are stored separately in this area."

Cited Reference ISAR Section 4.2.1.2, Paragraph 4

Evaluation Criteria DOE/RL-96-0003, Regulatory Process, Section 3.3.2, item 3, "The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled."

Discussion Dry chemical packaging is not defined. The dry chemical storage area weather protection is not defined.

Description
1. What is the weather protection for the dry chemical storage area?
2. What is the dry chemical packaging material?

Contractor Response The weather protection provided the dry chemical storage area is as described in ISAR Section 4.2.1.2. That is, a roof is provided but no walls. The dry chemicals will be packaged in reusable plastic or steel containers for storage in the dry chemical storage area.

Disposition The BNFL response is acceptable.

Question # 19 **Status** Acceptable

Cited Submittal Text None

Cited Reference ISAR, last paragraph of section 4.3.1.4

Evaluation Criteria DOE/RL-96-0003, Regulatory Process, Section 3.3.2, item 3, "The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled."

Discussion Resin degradation has potential downstream radiological effects

Description What is the projected resin capacity reduction per loading cycle, the basis for the projection and the effects on facility worker safety (e.g. cesium to the melter) should the degradation increase?

Contractor Response During Part A testing, Superlig 644 has demonstrated excellent radiation stability. This testing led to the conservative assumption that cesium ion exchange resin has a projected life of at least ten loading cycles (ISAR, page 4-72). Control of the ion exchange process occurs by monitoring the concentration of the radionuclides in the effluent. The condition of the resin doesn't have an impact on this system. If the resin has degraded, the loading time reduces. Facility personnel replace the resin when the reduced loading time has an adverse impact on operations. Further assessments during Part B will establish this parameter. Neither the degraded resin nor the reduced loading time contribute to a decrease in worker safety.

Disposition The BNFL response is acceptable but subject to the following:

It is correctly stated that reduced loading time as a result of degraded resin will not contribute to a decrease in worker safety. It is further stated that degraded resin will not decrease worker safety but no rationale is given especially where loaded degraded resin may accumulate downstream of the resin column in the effluent stream. In addition to the Part B commitment to review the resin replacement/loading cycles it appears prudent to review the potential for loaded degraded resin downstream of the resin column.

Question # 20 **Status** Unacceptable

Cited Submittal Text Table 4-37 of the ISAR

Cited Reference Initial Safety Analysis Report, BNFL-5193-ISAR-01, Rev. 0., Section 4.7

Evaluation Criteria RL/REG-97-11, Revision 1, Section 6.5 - Analysis of Design Basis Events

Discussion

There are many isotopes listed in Table TS-8-3 of the TWRS-P Privatization Contract for BNFL that are not listed in Table 4-37 for the HLW receipt tank such as I-129 and Y-90. These radionuclides are apparently not considered in the accident analysis as no explanation for this difference between the ISA and the contract values is provided in the ISA.

Description

1. Explain why the radionuclides included in the accident analysis differ from those listed in the TWRS Privatization Contract.
2. Discuss any impact on the computed doses.

Contractor Response

The complete list of radionuclides given in the contract as Table TS-8.3 was evaluated for the contribution of each to the inhalation dose. Envelope D concentrations were multiplied by the inhalation dose conversion factors from EPA-520/1-88-020, Limiting Values of Radionuclide Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion. It was found that the radionuclides listed in Table 4-37 contributed 99.5% of the total inhalation dose. No other individual radionuclide contributed more than 0.15%. Therefore, for subsequent analysis, only those radionuclides were included in the calculations.

Disposition

The BNFL response is unacceptable for the following reason:

Radioactive species should not be ignored at this early stage of the design. As the accident analysis matures, some of the nuclides that are being ignored may become significant contributors to predicted doses. As an example, the radioactive inventory trapped in the offgas system filters and scrubbers available for release during DBE may become significant. Nuclides such as I-129 may become a significant fraction of the total dose as the process becomes better-defined. The RU would expect BNFL to continue to look at a wide spectrum of radionuclides until the facility design is finalized.

Question # 21 **Status** Acceptable

Cited Submittal Text None

Cited Reference Initial Safety Analysis Report, BNFL-5193-ISAR-01, Rev. 0., Section 4.7

Evaluation Criteria RL/REG-97-11, Revision 1, Section 6.5 - Analysis of Design Basis Events

Discussion

For accidents involving high temperature molten glass spills (HAW/LAW option), it is assumed that radionuclides other than Cs and Te are not volatile. As the waste solution in the tanks is basic, it is possible that isotopes may exist in chemical forms that are volatile at the temperature of the molten glass. As an example, strontium hydroxide boils at 710 C, which is below the glass temperature in the melter of 1150 C. As a result, if strontium is in the hydroxide form, the potential release may be higher than given in the accident analysis. The impact of radionuclide chemistry in the source term in the ISA should be evaluated.

Description

1. Discuss the impact of radionuclide chemistry on the source terms used in the accident analysis.

2. Please cite operational experience at other facilities as appropriate.

Contractor Response

1) The HLW has undergone a series of pretreatment steps prior to reaching the melter. Process flow diagrams for the melter Design Freeze Package indicate that the carryover of strontium to the melter offgas (prior to the quench scrubber and recycling to the melter feed tank) is expected to be 0.01. This indicates that the chemistry is not favorable for significant volatilization of strontium at melter operating temperatures. For comparison, the corresponding values for cesium and technetium are 0.1 and 0.5 respectively.

For future analysis of the glass spill scenario, the effect of chemical form on the volatility of the radioactive components of the molten glass will be further investigated.

2) Analyses of the glass spill scenarios for the DWPF SAR state that "the chemical form of strontium in the molten glass is not volatile or semi-volatile". Those analyses used bench scale laboratory data from PNL that do not include strontium data. Earlier DWPF analysis used the same data from an operating melter that was used for the analysis in the TWRS-P ISAR. However, the data only included cesium.

The West Valley Demonstration Project SAR (see HAR, WVNS 1995) indicates that the radionuclide carryover data used for their SCFM off-gas jumper failure scenario, that bounds their glass spill analysis, was based on measured off-gas production rates. Investigation for future analysis of the TWRS-P glass spill scenario will include obtaining, where possible, measurement data from operating melters, and comparison of their chemistry with the TWRS-P glass chemistry.

Disposition

The BNFL response is acceptable but subject to the following:

The TWRS wastes are chemically very basic. The volatility of radioactive species in chemical forms under chemically basic conditions is the issue. Until it can be established that chemical volatility is not an issue, it is more prudent to assume a higher volatility in the hazard analysis as it will result in a more conservative estimate of the release. The reviewer was interested in experience from other facilities that have similar chemistry conditioning in their wastes. Both DWPF and the West Valley facilities process wastes that are chemically more acidic. Their experience may not provide much valuable insight in this case. The above concerns will be revisited by the RU as additional information from the BNFL proposed volatility analysis becomes available.

Question # 22 **Status** Acceptable

Cited Submittal Text

Section 4.3.2.3, page 4-78

Cited Reference

Initial Safety Analysis Report, BNFL-5193-ISAR-01, Rev. 0., Section 4.3

Evaluation Criteria

RL/REG-97-11, Revision 1, Section 6.5 - Analysis of Design Basis Events

Discussion

Some potentially high consequence scenarios may not have been analyzed. Page 4-78 second paragraph under section 4.3.2.3 contains a discussion about the treatment of I-129 using a dry absorption unit in the HLW melter primary offgas system. However, there is no accident scenario involving failure of this unit and I-129 release. Although the feed concentration of I-129 is low, continued accumulation on the adsorption units could result in a significant dose to the thyroid in the event of an accident. The possibility of an accident involving I-129 in the off gas adsorption unit should be evaluated.

Description

Discuss the impact of I-129 dose, due to failure of the off gas adsorption units, on the accident analysis, and on overall facility operation. If the I-129 contribution to the dose is negligible, then please state.

Contractor Response

Two initiating events associated with the iodine adsorption column were identified in the hazard evaluation of the HLW vitrification off-gas treatment system (see page 5-205 of the HAR). Initiator

No. 1 was a, "Dose uptake due to exposure during iodine adsorption column change" and initiator No. 2 was a, "Radiation dose due to activity breakthrough". A crane drop of the cartridge could dump the silver impregnated zeolite and its impact on a concrete would generate a dust cloud and as a consequence a possible "dose uptake". This is the more severe of the two events since a breakthrough of activity is unlikely to cause a long sustained undetected leak of the magnitude that would be equivalent in magnitude to a fully loaded column. The Hazard Evaluation team assigned a consequence severity of 1 to this event. The review of this event by the accident analysts did not find the characteristics were such as to warrant inclusion in the accident categories that were analyzed to determine the bounding events. As shown below, the dose from the failure of the iodine adsorber is negligible.

The Contract specification, Table TS-8.3 lists the concentration of I-129 in Envelope D or HLW waste as 9.0 E-08 Ci/l. The Basis of Design states that the maximum production of HLW glass product is 261,200 kg of glass in one year. Twenty five percent of the glass produced in the maximum year is the feed waste oxides (excluding sodium and silicon). Feed concentrations according to the contract specification range from 25g/l to 100 g/l (excluding sodium and silicon). The maximum amount of I-129 released will occur when the maximum volume in liters is processed through the HLW melter which will occur at the low end of the concentration range or 25 g/l and in the year that 261.2 Mt of glass is produced. The silver zeolite bed will be replaced once a year. Based on the maximum yearly production rate and the lowest concentration of nonvolatiles in the feed, the I-129 loading on the silver zeolite bed will be 8.7 E+09 Bq assuming that the adsorber removal efficiency is 100 percent. This inventory of the I-129 (material at risk) is equivalent to the health effects from an inhalation dose of 408 Sv which is less than any of the events identified in the screening analysis as requiring additional analysis to determine if it is a bounding accident. The I-129 dose conversion factor is 4.7 E-08 Sv/Bq. Without proceeding any further with a determination of the airborne release fraction and the respirable fraction, the screening analysis shows that in comparison to the other events the dose is negligible.

Disposition

The BNFL response is acceptable.

Question # 23

Status Acceptable

Cited Submittal Text

ISAR Table 4-13 Natural Phenomena Design Loads for SSCs with NPH Safety Functions
ISAR Table 4-14 Natural Phenomena Design Loads for SSCs without NPH Safety Functions.
SRD Table 4-1 Natural Phenomena Design Loads for Design Class I SSCs.
SRD Table 4-2 Natural Phenomena Design Loads for Design Class II SSCs.

Cited Reference

BNFL-5193-ISAR-01, Rev.0
BNFL-5193-SRD-01, Rev. 0

Evaluation Criteria

RL/REG-97-11, Section 6.1, 6.2, & 6.6

Discussion

The SRD stated that SSCs required to perform safety functions are designated as Design Class I or Design Class II. The NPH design criteria for DC-I and DC-II are listed in SRD Table 4-1 and Table 4-2, respectively. But ISAR Table 4-13 and Table 4-14 lists NPH design loads with and without NPH Safety Functions. It is not clear how design classes and NPH Safety Functions are related.

Description

Please describe how seismic categories relate to design classifications (DC-I, DC-II, and DC-III).

Contractor Response

Tables 4-1 and 4-2 of the SRD Criteria 4.1-3 and 4.1-4 were reviewed and revised in response to RU comments on the SAP deliverable. The revised tables were included in the SRD Rev. 1 submitted to the RU on December 17, 1997. The ISAR tables are consistent with the revised SRD tables.

Based on SRD Criteria 4.1-3 and 4.1-4:
SSCs which are designated Safety Design Class and are required to perform a safety function as the result of a seismic event are required to meet the seismic criteria described in SRD Table 4-1. In addition,

(a) if a SSC is not required to perform a safety function as a result of a seismic event; but
(b) the failure of the SSC during the seismic event could reduce the function of another Safety Design Class SSC to such that the worker or public exposure criteria in SRD 2.0-1 or 2.0-2 are exceeded; then
(c) the SSC is required to meet the seismic criteria described in SRD Table 4-1.

Also see responses provided for Question 1 (for NPH consideration) and Question 33 (for changes in the classification of SSCs).

Disposition

The BNFL response is acceptable.

Question # 24 **Status** Acceptable

Cited Submittal Text

SRD Table 4-2, Natural Phenomena Design Load for Design Class II SSCs, Design Load of Seismic Hazard, Importance Factor, I=1.0

Cited Reference

BNFL-5193-SRD-01, Rev.0
DOE-STD-1020-94

Evaluation Criteria

RL/REG-97-11, Section 6.1 & 6.6

Discussion

BNFL committed to the UBC codes and the essential facilities occupancy category for the design loads of DC-II SSCs. The UBC codes specifies that the importance factor for essential facilities is I=1.25. BNFL listed the seismic load design factor as I=1.0. Justification is needed for selecting the I=1.0 importance factor.

Description

What is the justification for using an importance factor of I=1.0 for seismic design of DC-II SSCs when BNFL committed to the essential facilities category of the UBC?

Contractor Response

The apparent inconsistency noted in this question results from the fact that Tables 4-1 and 4-2 given in Revision 0 of the SRD (as invoked by Safety Criteria 4.1-3 and 4.1-4) do not accurately reflect the approach to NPH design being taken by BNFL. Revised criteria and tables were provided to the RU as part of the draft Revision 1 to the SRD (ref: BNFL letter 5193-97-0564 dated December 17, 1997).

In summary, the usage of Tables 4-1 and 4-2 of the SRD - as noted in the draft Revision 1 - is as follows:
· Table 4-1 is applicable to the NPH design of Safety Design Class SSCs that are required to perform a safety function as a result of a natural phenomena hazard. (See response to Question 33 for change in classification of SSCs).
· Table 4-2 is applicable to the NPH design of Safety Design Class SSCs that are not required to perform a safety function as a result of a natural phenomena hazard.

Safety Design Class SSCs that are not required to perform a safety function as a result of a NPH are non-essential facilities. Consequently, for the seismic design of such SSCs, I = 1.0 in accordance with UBC-1994, Table 16-K for "Standard Occupancy Structures."

The draft Revision 1 version of SRD Table 4-2 erroneously contains an "Essential Facilities" designation, which will be removed. A corrected version of Table 4-2 showing its appropriate applicability is attached.

Disposition

The BNFL response is acceptable but subject to the following

The building contains enough quantity of hazardous chemicals that it should be more appropriately categorized as "hazardous facilities" for the purpose of selecting seismic and wind design importance factors in the UBC code. BNFL's original designation, "essential facility," was comparable to "hazardous facilities" (I=1.25) and was acceptable. BNFL's response to change the facility to "standard occupancy structures" is not acceptable. On 3/9/98, BNFL agreed to design the building to DBE (0.24g). The approach will be acceptable provided the above revisions are implemented.

Question # 25 **Status** Unacceptable

Cited Submittal Text SRD 4.1 General Design, Safety Criterion: 4.1-2 Implementing Codes and Standards.
ACI-38-95
ACI-318R-95
ACI-349-90

Cited Reference BNFL-5193-SRD-01, Rev.0

Evaluation Criteria RL/REG-97-11, Section 6.1 & 6.6

Discussion Eleven codes and standards are quoted by the contractor. Each code or standard has a similar design philosophy but a slightly different design capacity and load combination method. BNFL defined different design safety classes, but has not explained the design philosophy or code selection criteria for each design safety class. BNFL should specify what load combination methods (by referring to a specific standard or code) and design capacity criteria (also by referring to a specific standard or code) that will be used for the various structural material (reinforced concrete and steel) that is distinctive to different design safety class SSCs.

Description What are the design parameters such as load combination methods and design capacities (by referring to a specific code or standard) for Design Class I and Design Class II SSCs? How will design criteria conflicts between different codes and standards be resolved?

Contractor Response Application of listed design codes to SSCs important to safety (see Question 33 response for change in classification of SSCs) is identified in the specific criteria addressing the items. See SC 4.1-3 and SC 4.1-4 as examples. Additionally, ISAR Section 4.2.2 identifies the civil and structural codes used in the design of the TWRS-P Facility on a system and an important to safety basis.

BNFL Inc. acknowledges that design criteria conflicts between different codes and standards may arise. Load combination methods and design capacities will be addressed in Part B.

Disposition The BNFL response is unacceptable for the following reason:

The codes and standards should be identified before the engineering design starts. Any conflict in codes should be identified and resolved earlier than the design process. In the planning stage, the resolution principle should be that the most conservative code takes precedence if several codes are potentially usable. It is not acceptable to pick and choose codes on some other basis without justification. The RU will continue review of this issue during the PSAR stage.

Question # 26 **Status** Acceptable

Cited Submittal Text ISAR Section 4.2.2

Cited Reference BNFL-5193-ISAR-01, Rev.0

Evaluation Criteria RL/REG-97-11, Section 6.1 & 6.6

Discussion
The text presented in the ISAR does not describe what structural systems are used in the design of the process building or any other building. Nor did the text describe what is the safety class or what functions the main process building is required to perform under NPH loads.

Description
1. To what structural system criteria will the process building be designed?
2. What safety functions are the main process building and other buildings designed for during NPH events?
3. Is confinement a requirement for the building? If so, what is the impact on the design allowable stress?
4. If the design class of the building is lower than the contained equipment, what is the impact during a NPH event when the external loads exceed the design loads of the building?

Contractor Response
1. The response to Question 46 identifies those portions of the process building that are classified as important to safety (see Question 33 response for change in classification of SSCs) . No portion of the process building is classified as Safety Design Class. The structural criteria applied to the important to safety portions of the process building are provided in SRD Volume II (currently as DC II).

2. For the HLW/LAW option, the process building must be designed to not fail in such a manner that it fails the HLW receipt tanks during a seismic event. The allowable stress for structures, systems, and components will be provided in the Part B PSAR.

3. Some of the process cells of the process building serve confinement functions as discussed in response to Question 46.

4. For "two over one" situations the structure is not allowed to fail such that it challenges the function of the protected structure, system, or component.

Disposition
The BNFL response is acceptable but subject to successful resolution of issues raised by the RU disposition of question 24.

Question # 27 **Status** Acceptable

Cited Submittal Text
ISAR Section 4.2.2.2, Seismic analysis of the process building.

Cited Reference
BNFL-5193-ISAR-01, Rev.0

Evaluation Criteria
RL/REG-97-11, Section 6.1 & 6.6

Discussion
A lumped-mass stick model only captures the stiffness, mass, and damping characteristics of the structural system. It is a model which is good for developing the global structural response such as in-structure floor response. But the lumped mass model does not provide adequate local structural element stress information. When structural system integrity is important in preventing "two-over-one" damage to other safety related SSCs or providing system confinement, a lumped-mass structural model is inadequate for detailed structural analysis.

Description
1. If "two over one" considerations are important in facility design, what are BNFL's plans to evaluate local stress of structural elements, such as the integrity of concrete beam elements or the cracking of wall or floor panels during NPH events?
2. If confinement is an important function of the facility, what is the evaluation criterion?

Contractor Response
These issues will be addressed in Part B.

Disposition
The BNFL response is acceptable but subject to the following:

The lumped mass stick model is an acceptable structural analysis method provided the requirements in ASCE 4-86, sections 3.1 are followed. The RU will review the PSAR for this aspect of the structural analysis.

Question # 28 **Status** Acceptable

Cited Submittal Text ISAR Section 4.2.2.3, Design for Natural Phenomena Hazards
a)...a static analysis is applied to these SSCs that could fail design Class I and II SSCs. ...b) piping is designed to meet faulted conditions, c) ductwork is not allowed to collapse.

Cited Reference BNFL-5193-ISAR-01, Rev.0
DOE-STD-1020-94
DOE-STD-1021-93

Evaluation Criteria RL/REG-97011, Section 6.1 & 6.6

Discussion a) DOE-STD-1021-93, Table 2-1 has clear guidelines on the system interaction effects for performance categorization. If a SSC is upgraded to the DC-I category in order to prevent system interaction then a dynamic analysis is required according to DOE-STD-1020-94, Table 2-5. A static analysis in not in compliance with DOE-STD-1020-94.

Description a) What is the justification for not complying with DOE-STD-1020 and DOE-STD-1021 in the SSC design for NPH to prevent system interaction?
b) What is BNFL's definition of faulted conditions?
c) What is the justification of ductwork design criteria if the ductwork has to maintain confinement for a safety requirement?

Contractor Response a) The system interaction effects for NPH will be in conformance to DOE-STD-1020 and DOE-STD-1021 n accordance with SRD Safety Criterion 4.1-3.

b) Faulted conditions would be similar to Service Level D of ASME Section III.

c) For ductwork that must maintain its functional capability to mitigate the consequences of a seismic event. That is, the first paragraph of Section 4.2.2.3 would apply to this ductwork.

Disposition The BNFL response is acceptable.

Question # 29 **Status** Acceptable

Cited Submittal Text pp. 4-90 to 4-92 and page 5-7 and 5-11

Cited Reference ISAR

Evaluation Criteria RL/REG-97-11, Section 6.8, Adequacy of the projected safety basis for the facility and its operation.

Discussion The ISAR gives an adequate description of the ventilation confinement zones and relative pressures within the process facility. However, the cell ventilation system will likely be relied upon to mitigate various in-cell pressurization events.

Description

1) How will the facility air balance (pressures) and airflows be designed and quantified to assure that the C5 and C4 zones do not pressurize above differential pressure conditions under the proposed accident scenarios?
2) How is defense in depth applied to this system (blowers, etc.)?
3) What is the BNFL general philosophy in this area (air balance requirements to mitigate accident scenarios, minimum cell turnovers per hour, minimum velocity across cell penetrations, etc.,)?

Contractor Response

1. BNFL has not performed a detailed analysis of the effects of over pressurization on the C5 extract. However, the relatively large volume ratios of the cell to equipment (in the Pretreatment Cell the ratio is > 10,000:1) suggests that the C5 systems should easily handle the event. BNFL will examine impact of over pressurization during Part B .

2. The C5 extract system has two sets of HEPA filters in series and 3 50-percent fans. Each HEPA filter set has 5 filters on line and one in standby. The fans have automatic change over on demand.

3. The time to build up to significant (i.e., >4%) hydrogen concentrations is proportional to the ullage space. Although large vessels have a higher material at risk, they have larger ullage spaces and the time taken to build up to >4% hydrogen may be long (several days). A judgment will be made as to the credibility of a long time period beyond which a recovery operation (and hence removal of the explosion potential) can be reasonably expected to occur. It boils down to the question as to whether or not there are any unrevealed failures of the passive protection that would not be discovered in a credible period of time.

Protection is by prevention, this will be by passive engineered features. This means the passive features of the ventilation system (e.g. ductwork arrangement from vessels) are to be designed such that credit can be taken for buoyancy effects of hydrogen gas as a driving force in preventing an accumulation of gas within vessels at risk. Hydrogen would be removed from ullage spaces and diffuse throughout the system. No credit is taken for an operating (active) air purge or forced extract system. Justification will be required to show that the hydrogen behavior within the TWRS-P ventilation system under quiescent conditions will not give rise to concentrations 4% over a credible period of time. In reality, an equilibrium concentration would be reached.

Depending on the potential consequences of a hydrogen explosion (vessel specific), the passive engineered features will attract some safety significance (important to safety).

3) The main objective of the ventilation systems, for the Process Building, is to support the confinement of sources of contamination, principally by air flows and pressure differentials designed to promote air flow from areas of lesser contamination potential to areas of greater contamination potential.

The ventilation of nuclear facilities is generally based on full fresh air once through systems. Consequently the energy costs associated with treating the supply air (heating, cooling, humidification) and the facility costs associated with filtering the exhaust air are relatively high. Similarly, the radioactive waste arising from contaminated HEPA filters and the costs for filter disposal increase with increasing air flow through the system. Therefore, the design of ventilation systems for nuclear facility should attempt to minimize the total air flow through the system from inlet to discharge.

Past BNFL Sellafield experience has shown that where minimum air change rates, for a given classification of area, have been used as a basis for ventilation design, this has resulted in higher air flows and a bigger ventilation plant than is necessary to meet design objectives. Air change rates therefore, are now only used at the concept design stage for the purpose of allocating space for the ventilation plant.

In meeting the design objectives the corresponding design flows give the following approximate air change rates for the LAW and HLW Facility.

AREA	Air change/hr
C5 Pre-Treatment Cells	< 1 overall
C5 HLW Line	2 to 8
C5 LAW Line	1 to 16
C3 Areas	2 to 10
C2 Areas (via C2 Extract)	<1 to 8

Disposition

The BNFL response is acceptable.

Question # 30 **Status** Acceptable

Cited Submittal Text "The HLW receipt tanks (HLW/LAW option) are designated as Design Class I. The LAW receipt tanks…. are designated as Design Class II"

Cited Reference Section 4.3.1.11 Waste Treatment, Pretreatment, and Vitrification Interfaces and Design Criteria (page 4-75)

Evaluation Criteria Safety Criterion 4.2-4

Discussion The process description states that the receipt tanks are designated as either Design Class I or II. However, the design classification for the supporting electrical and control systems are not stated in the process description. It is not clear whether the DC I or DCII design classifications for the tanks are only for structural integrity or for operational requirements as well.

Per discussions on January 28, 1998 (R.Smith, D.Edwards et.al) we understand that all systems needed to support DC-1 or DC-2 systems will be classified the same as the system being supported. Please confirm that our understanding of this philosophy is correct as part of your response to this question.

Description Are the electrical and I&C systems classified in the same design class as the associated LAW or HLW/LAW receipt tanks?

Contractor Response Yes, support systems required to provide the safety feature of the Safety Design Class system will be designated with the same design class.

Specifically, as identified in ISAR Section 4.8.1.1, the HLW receipt tank has been designated as Safety Design Class, to protect the public in a DBE. This protection is provided by the passive function of maintaining tank integrity (see Question 33 response for change in classification of SSCs). No supporting electrical or I&C systems are needed to maintain the tank integrity. Therefore, even though the tank is designated as Safety Design Class, no support systems are needed to assure maintenance of tank integrity during the design bases earthquake and no supporting systems are designated as Safety Design Class.

As identified in ISAR Tables 4-46 and 4-47, the LAW receipt (and several storage tanks) have been designated as Safety Design Class. The table also states that the preventive feature provided is to maintain integrity of the tank during a DBE. This is a passive feature and no supporting electrical or I&C systems are required to maintain tank integrity. Therefore no support systems are designated as Safety Design Class.

It should also be noted that the C5 extract system, including ducts, stack, and fans, is designated as Safety Design Class. The table also notes that supporting electrical, I&C, and air systems are needed to perform the safety function. These support systems are therefore designated as Safety Design Class, because the C5 extract system could not provide the required radiological protection without the support systems. But the Safety Design Class designation is only required for those portions of the support systems that actually support the safety function. For example, a local indicating lamp may indicate that the fan is operating, but failure of the lamp would not prevent the safety function. Therefore the individual component lamp would not be Safety Design Class. If a damper in the system was required to maintain radiological exposure standards and was maintained closed during normal operations, and failed in the closed position, the electrical power required to open the damper would not be required to provide the safety function. In this case, the damper would be Safety Design Class, but the supporting electrical power would not.

Disposition The BNFL response is acceptable.

Question # 31 **Status** Acceptable

Cited Submittal Text

Standard Approval Package:
Contractor's response to Question No. 3 states that the analysis for NPH initiated events will be addressed in the initial Safety Analysis Report.

ISAR
Section 4.3.9.2 "…Standby power at 13.8 kV is supplied by three parallel diesel generators to support the LAW melter loads and HLW melter loads…. Standby power at 480 V is provided from a single Design Class II diesel generator."

Cited Reference

Initial Safety Analysis Report:
Section 4.3.9 - Electrical Power (page 4-101)
Section 4.3.10 - Instrumentation and Control Systems (page 4-105)
Section 4.8 - Controls for Prevention and Mitigation of Accidents

Standard Approval Package:
Question Response No. 3 addressed in " BNFL's Supplemental Responses to Review Team's Questions on the Standards Approval (SA) Package", Memorandum from D. Clark Gibbs to M.J.Bullock, dated Jan.13, 1998, 98-RU-0007.

Evaluation Criteria

RL/ REG-97-11, Section 6.1 & 6.6

Discussion

The reviewer was led to believe following the response to Question No. 3 cited above, that the loss of off-site power event causing multiple process systems failures and the resulting consequences would be analyzed in the ISAR. However, the ISAR did not present the results for a loss of offsite power event.

Total loss of power (either due to natural phenomena hazard, fire in the switchgear room, etc.) is a credible event. The proposed electrical power system will have no DC I power system, only one DC II diesel generator for the support of the DC II portion of the HVAC system, and three DC III diesel generators. Since no credit can be taken for DC III diesel generators availability to mitigate accident scenarios, it does not appear that the proposed power system design fulfills the defense in depth philosophy. The electrical power system is a common support system for all process operation and controls. Its failure may affect multiple process systems and the severity of such common cause failure events may not have been thoroughly evaluated.

Section 4.8, "Controls for Prevention and Mitigation of Accidents" summarizes the results of the safety analyses and identifies the engineered and administrative controls needed to mitigate the accident scenarios. However, it is not clear whether the electrical power source is being used to support any mitigative features. If the electrical power is used to prevent or mitigate any of these accident scenarios, it should be designed to Design Class I or II as appropriate.

Section 4.8, "Controls for Prevention and Mitigation of Accidents" states that the support systems for the C5 extract and the ammonia and nitric acid isolation systems would require DC II electrical power system (i.e., single DC II diesel generator) to prevent and mitigate the accident scenarios. It is not clear in the case of loss of diesel generator failure whether any other diverse system is available to mitigate the scenario.

Description

1. Is the "domino effect" of multiple process systems failures considered due to total loss of power? If yes, what are the consequences and what measures taken to mitigate such scenarios?

2. Except for DC II diesel generator for the C5 HVAC, is the normal power source (including DC III UPS and batteries) used to prevent and mitigate the accident scenarios addressed in Section 4.8?

3. Which systems will be relied upon in the event that the DC II diesel generator fails to support the C5 HVAC system and the ammonia and nitric acid isolation systems?
4. What is the design philosophy behind electrical and control system design given the large number of DC I/II SSCs listed in Section 4.8.1, particularly in Tables 4-47 and 4-48 of the ISAR?

Contractor Response

1) The bounding case for loss of power is incorporated into the design basis earthquake scenario described in Section 4.7.2.10 of the ISAR. It is assumed that offsite power is lost due to the earthquake. Because the primary confinement remains intact, no significant releases attributable to the power loss were identified.

2) The Safety Design Class diesel generator is identified as a backup power source for the Safety Design Class C5 extract system relied upon to mitigate the consequence of several in-cell system

failure scenarios. (See response to Question 33 for change in classification of SSCs.) No other power sources are identified as needed to prevent or mitigate the consequences of accident scenarios, because the diesel is assumed to function. The overall risk assessment planned for Part B will evaluate this assumption.

Disposition

The BNFL response is acceptable, but subject to the following:

Section 4.7.2.10, of the ISAR does not appear to explain how the loss of offsite power is incorporated in the analysis. The Regulatory Unit believes that the ISAR is deficient in not establishing a comprehensive design basis event (DBE) scenario that includes loss of offsite power as a common cause event. This issue was raised during the review of the Hazards Analysis Report (Question No 3 for the ISA Package, Letter 98-RU-0007). The occurrence of fire, earthquake or other NPH event may cause multiple process systems failures and may also cause a concurrent loss of offsite power. This "domino effect" of electrical power failure causing failure of multiple process systems needs to be evaluated. Electrical failures (e.g., faulty wiring due to fire, etc.) at a subsystems level have been analyzed. However, this analysis, which is at a system or sub-system level, does not identify critical needs for on-site electrical power sources. Mitigation of the DBE may require electrical power sources, and credit cannot be taken for normal offsite power for such mitigation. Also, the response to Item 4 (of the Question) states: "All the systems identified as mitigating or preventing releases during and after a design basis earthquake are passive." The concept of passive design appears ideal. However, reviewers expressed skepticism over BNFL's claim that mitigative and preventive systems can be designed without the need for electrical power. This design feature will be examined in detail as the facility design developed.

3) The Safety Design Class diesel generator is a backup system to support continued operation of the C5 extract system and ammonia and nitric acid isolation systems, in the event offsite power is unavailable at a time when any of those systems are being relied upon to mitigate the consequence of an accident. The accident scenarios that led to the identification of those systems as Safety Design Class currently do not assume initiators that could disable both offsite and backup power. Therefore, simultaneous loss of offsite power and backup power when their Safety Design Class function is required is not included in the assumption. Thus, from the perspective of mitigating or preventing consequences of accidental releases, other systems to provide power in the event of diesel generator failure have not been identified. This overall assumption will be examined from a risk perspective during the Part B assessment.

4) All the systems identified as mitigating or preventing releases during and after a design basis earthquake are passive. Therefore, operation of electrical and control systems following the design basis earthquake is not required. Because operation of C5 extract system is relied upon for mitigation of exposure to both co-located worker and facility worker in the event of in-cell releases due to failures other than the earthquake, it is designated Safety Design Class All support systems, including electrical power, that assure the continued safety function of the C5 system are also designated as Safety Design Class.

Question # 32 **Status** Acceptable

Cited Submittal Text pg 4-76, bottom paragraph

Cited Reference BNFL-5193-ISAR-01, Chpt. 4

Evaluation Criteria RL/REG-97-11, Section 6.6, The adequacy of the categorization of SSCs that are important to safety.

Discussion

The last paragraph appears to be jumbled text regarding the SSC classification for transfer lines for the LAW and HLW/LAW options. However, since the text is jumbled it is difficult to understand what exactly the design classification is for the transfer lines. This text may not even be in the appropriate sections of the Chapter.

Description

What is the design classification for the LAW and HLW transfer lines for the proposed options?

Contractor Response

The following paragraph will be deleted from page 4-76, because the information is presented correctly in preceding paragraphs.

"This is the LAW transfer line for both LAW and HLW/LAW options. What is Design Class for HLW transfer line? The tank 241-AP-106 transfer line is designated as Design Class II. Other components related to waste receipt, pretreatment, and vitrification are designated as Design Class III. However, for defense in depth, the technetium concentrated storage tank (LAW-Only option), the cesium product storage tank (HLW/LAW option), and the HLW receipt tank (HLW/LAW option), and the HLW receipt tank (HLW/LAW option), are designed to withstand the DBE of SRD Safety Criterion 4.1-3."

The HLW transfer line will be designated as Safety Design Class (See response to Question 33 for change in classification of SSCs). However, in responding to this question, BNFL Inc. has determined that the HLW transfer line is not adequately addressed in the accident analysis. This will be corrected in Part B.

Disposition

The BNFL response is acceptable but subject to the following:

The answer acknowledges and commits to removing the jumbled text and provides the SSC classification for the HLW transfer line as SDC. It also acknowledges the inadequacy of the HLW transfer line in the accident analysis and commits to correcting this in Part B.

Question # 33 **Status** Acceptable

Cited Submittal Text

Page 4-8, pg. 4-65,

Cited Reference

BNFL-5193-ISAR-01, Chapter 4

Evaluation Criteria

RL/REG-97-11, Section 6.6, The adequacy of the categorization of SSCs that are important to safety.

Discussion

The SRD (BNFL-5193-SRD-01) identified 4 designations of classification for important to safety (DC I, II, III & non). Yet in various locations throughout the ISAR several new terms are identified with respect to equipment important to safety. They include:
pg 4-8 - SSCs both with and without NPH safety functions
pg 4-65 - SSCs required to perform a safety function
pg 4-65 - SSCs identified as performing safety functions, i.e. , DC I or II

Description

Please reconcile the various definitions and descriptions of equipment important to safety in the ISAR to those found in the SRD.

Contractor Response

The terms "DC III" and "non DC" are not used in the SRD. Reference to DC III and not Design Class I or II will be removed from the ISAR in Part B.

The use of the terms SSCs with and SSCs without safety NPH Safety functions is consistent with the SRD revision in response to SAP question 12, please see response to question 23.

As discussed in ISAR Appendix 1A, Section 6.0, "Conformance with the Important-to-safety Concept", the classification of SSCs as Design Class I and II will be replaced with designation of SSCs as important to safety. SSCs designated as "important to safety" for the TWRS-P Facility include the following.

1) SSCs needed to prevent or mitigate accidents that could exceed public or worker radiological and chemical exposure standards and SSCs needed to prevent criticality. This set of SSCs includes front line and support systems needed to meet these exposure standards. This set of important to safety SSCs are further designated as Safety Design Class.

2) SSCs needed to achieve compliance with the radiological or chemical exposure standards for the public and workers during normal operation; and SSCs that place frequent demands on, or adversely affect the function of Safety Design Class SSCs if they fail or malfunction.

The ISAR, ISMP, and SRD will be revised in Part B to reflect this change. When revised, reference may be made in these documents to SSCs not designated as important to safety.
For the terms "SSCs required to perform a safety function" and "SSCs identified as performing a safety function" there is no inconsistency. The first term describes the philosophy applied to all SSCs performing a safety function the second term is reflective of the nature of the Facility design and that at this point in time not all SSCs performing safety functions have been identified.

Disposition The BNFL answer is acceptable.

Question # 34 **Status** Acceptable

Cited Submittal Text Section 4.3, 4.3.2.6, 4.3.3, 4.3.4, 4.3.5, 4.3.6 and throughout

Cited Reference BNFL-5193-ISAR-01, Chapter 4

Evaluation Criteria RL/REG-97-11, Section 6.6, The adequacy of the categorization of SSCs that are important to safety.

Discussion The SRD (BNFL-5193-SRD-01) identified 4 designations of classification for important to safety (DC I, II, III & non). Yet in various locations throughout the ISAR in Section 4.3, most systems are listed as "not designated DC I or II". They include:
4.3.2.6 Melter off gas system
4.3.3 Process vessel vent system
4.3.4 Water and steam systems (all subsections)
4.3.5 Air and vacuum systems (all subsections)
4.3.6 HVAC (selected subsections)
4.3.7 Fire Protection
4.3.9 Electrical Systems (selected subsections)

Description Please define what design classification applies to systems that are designated "not Design Class I or II." Also, please describe the justification that supports each statement of design classification for each system included in the above examples.

Contractor Response As discussed in ISAR Appendix 1A, Section 6.0, "Conformance with the Important-to-safety Concept", the classification of SSCs as Design Class I and II will be replaced with designation of SSCs as important to safety. SSCs designated as "important to safety" for the TWRS-P Facility include the following.

1) SSCs needed to prevent or mitigate accidents that could exceed public or worker radiological and chemical exposure standards and SSCs needed to prevent criticality. This set of SSCs includes front line and support systems needed to meet these exposure standards. This set of important to safety SSCs are further designated as Safety Design Class.

2) SSCs needed to achieve compliance with the radiological or chemical exposure standards for the public and workers during normal operation; and SSCs that place frequent demands on, or adversely affect the function of Safety Design Class SSCs if they fail or malfunction.

The listed systems and subsystems are not be identified as important to safety as they are not credited for achieving either of the above two listed functions.

Disposition The BNFL answer is acceptable.

Question # 35 **Status** Acceptable

Cited Submittal Text Section 4.3.9.9, DC II Electrical Circuits

Cited Reference BNFL-5193-ISAR-01, Chapter 4

Evaluation Criteria RL/REG-97-11, Section 6.6, The adequacy of the categorization of SSCs that are important to safety.

Discussion Volume II of the SRD (BNFL 5193-SRD-01) provided specific requirements in its definitions of DCI and DC II SSCs. One safety criterion (4.4-9) specifies physical and electrical separation for equipment designated as DC I. There is no requirement for electrical separation for DC II equipment listed in the SRD. Yet in the ISAR, Section 4.3.9.9 it states that DC II Electrical circuits "...are physically separated from other equipment, cables, and circuits to increase availability..."

Description Please reconcile the difference in requirements between DC II electrical circuits listed in the SRD versus those listed in the ISAR. Which requirement or commitment takes precedence (i.e., the SRD or ISAR)?

Contractor Response As discussed in ISAR Appendix 1A, Section 6.0, "Conformance with the Important-to-safety Concept", the classification of SSCs as Design Class I and II will be replaced with designation of SSCs as important to safety. SSCs designated as "important to safety" for the TWRS-P Facility includes SSCs needed to prevent or mitigate accidents that could exceed public or worker radiological and chemical exposure standards and SSCs needed to prevent criticality. This set of SSCs includes front line and support systems needed to meet these exposure standards. This set of important to safety SSCs are further designated as Safety Design Class.

ISAR Appendix 1A provides the design attributes of Safety Design Class SSCs. The second attribute is:

"2. For active systems and components, the safety function is preserved by application of defense in depth such that the failure of an active system or component will not result in the exceedance of a worker or public exposure standard. For a mitigating feature, this means that given that the accident has occurred, the consequence of the accident will not result in the exceedance of a worker or public exposure standard. For a preventative feature, this means that the failure of the system or component will not allow the accident to occur and progress such that a worker or public exposure standard is exceeded. This requirement may be achieved by designing the Safety Design Class system or component to withstand a single active failure or by designating two separate and independent Safety Design Class systems or components."

The electrical separation requirements of SRD Safety Criterion 4.4-9 is applied to this single failure/diversity attribute of SSCs designated as Safety Design Class.

Disposition The BNFL response is acceptable.

Question # 36 **Status** Unacceptable

Cited Submittal Text Section 4.3.7, Fire Protection System; Chapter 8, Fire Safety

Cited Reference ISAR

Evaluation Criteria RL/REG-97-11, Section 6.1.1, Defense-in-Depth; Section 6.2.1, Compliance with the SRD.

Discussion

During the initial stages of the review of the SRD and the HAR, the RU concluded that BNFL had not defined a comprehensive fire protection program, sufficient to achieve defense-in-depth. Subsequently, in response to RU Question 39, BNFL expanded the Safety Criterion for fire safety and adopted DOE fire safety guidance (the Implementation Guide to DOE Order 420.1, "Fire Safety") and the DOE Fire Protection Design Criteria Technical Standard (DOE-STD-1066-97).

The fire protection-related portions of the ISAR do not reveal the implementation of these commitments. Consequently, the ISAR does not provide a technical basis for concluding that defense-in-depth will be achieved.

Description

To what extent does the ISAR reflect BNFL's commitment to expand the Fire Safety Criterion and adopt the-above-referenced DOE Fire Safety Guidance and Fire Protection Design Criteria?

Contractor Response

In the question and answer process for the SAP, BNFL Inc. committed to using G 440.1 and DOE-STD-1066 in the design and construction of the TWRS-P Facility. This commitment is reflected in ISAR Section 4.2.4 and was included to assure the reviewer that the DOE guides would be incorporated into the Fire Hazards Analysis process.

Additionally, ISAR Section 4.3.7.4 states
"The fire protection system is designed to the following implementing codes and standards:
1) NFPA 214, Standard on Water-Cooling Towers
2) DOE G-440.1, Implementation Guide for use with DOE Orders 420.1 and 440.1 Fire Safety Program
3) DOE-STD-1066, Fire Protection Design Criteria
4) NFPA 801, Standard for Facilities Handling Radioactive Materials."

During Part B, this commitment will be reiterated in SAR Section 8.3.

Disposition

The BNFL response is not acceptable for the following reason:

While BNFL has indicated that some of the adopted Safety Criterion and Implementing Codes and Standards can be found within the text of the ISAR, the manifestation of a fire hazard defense-in-depth philosophy can not. A comprehensive and adequate fire safety program is multifaceted and includes: fire protection policies and procedures; thorough fire hazards analyses; physical fire protection features; and an emergency services capability, among other aspects. The description of each of these facets should be couched in terms of the applicable fire safety criteria and DOE and National Fire Protection Association Standards. This has not been done in the ISAR. The RU will pursue the resolution of this issue during future interactions with BNFL.

Question # 37 **Status** Acceptable

Cited Submittal Text

See cited sections

Cited Reference

Initial Safety Analysis Report, BNFL-5193-ISAR-01, Rev. 0., Section 4.1, Safety Requirements Document Volume II and BNFL-5193-SRD-01, Rev 1 Draft, Section 4.1 and 4.2

Evaluation Criteria

RL/REG-97-11, Revision 1, Section 6.4 - Selection of Design Basis Events

Discussion

BNFL has added Administrative Standards in Section 4.0 of the SRD Volume II Rev.1 (draft). Among the sections referenced in the SRD are Classifications of SSCs, Facility Design for Postulated Events, Defense in Depth, Quality Levels, and Proven Engineering practices. It is not clear whether these standards are consistent with the implementing codes and standards in Section 4.1-1 through 4.1-5 and 4.2-1 and 4.2-2 of the SRD and Section 4.0 of the ISAR.

Description

Discuss the consistency between the cited implementing codes and standards in the ISAR and SRD and the BNFL Administrative Standards.

Contractor Response

As stated in Question 35, the SRD establishes minimum requirements. However, based upon prudent design practices, the ISAR may contain commitments that are more conservative than the minimum requirements specified in the SRD. As such, the BNFL Administrative Standards compliment the Design Standards. The Design Standards cited typically provide methodologies and criteria establishing acceptable engineering and design parameters such as load combination, allowable stresses, deflections, and acceptable environmental conditions (e.g., service designations, pressure ranges, and temperature). The applicable requirements from the design standards are implemented through the use of the institutionalized programs such as classification of SSCs, configuration management, including change controls on those SSCs, and quality assurance.

For example, SRD Safety Criterion 4.2-2 specifies requirements for Important to Safety SSCs (See response to Question 33 for change in classification of SSCs). There is no implementing standard for designation of Important to Safety, so the BNFL Administrative Standard identifies ISMP Section 1.3.10 to be used for the classification.

If an instance occurs where a code specifies a more stringent requirement than the ISAR, such as an independent review of a calculation which is not required based on the quality level for the component, an independent review would be performed. Similarly, if the design code did not require an independent review but based on the quality level an independent review is required, the independent review would be performed.

Disposition

The BNFL response is acceptable with the following comment:

The response is acceptable, however, a portion of the response, " For example SRD Safety Criterion 4.2-2 specifies requirements for Important to Safety SSCs (See response to Question 33 for change in classification of SSCs). There is no implementing standard for designation of Important to Safety, so the BNFL Administrative Standard identifies ISMP Section 1.3.10 to be used for the classification." The cited section of ISMP is not consistent with the safety classification concept currently being envisaged in Appendix1A to the ISAR as discussed in the response to Question 33.

Question # 38 — Status Acceptable

Cited Submittal Text

See section cited above

Cited Reference

Initial Safety Analysis Report, BNFL-5193-ISAR-01, Rev. 0., Section 4.1.3.1 (wind) and 4.1.5.3 (seismic hazard)

Evaluation Criteria

RL/REG-97-11, Revision 1, Section 6.4 - Selection of Design Basis Events

Discussion

DOE has issued a newsletter (Interim Advisory on Straight Wind and Tornadoes) dated January 22, 1998 which lists the recommended peak wind gusts based on ASCE 7-95. Accordingly, the 1000 year return period peak gust wind speed at Hanford is determined to be 111 mph. A copy of the newsletter is enclosed.

Description

The ISAR and SRD should reflect the wind speed referenced above.

Contractor Response

The ISAR was developed based on the SRD. The SRD was developed based on DOE-STD-1024-94, which was the current DOE accepted standard when the SRD and ISAR were submitted. The Interim Advisory on Straight Winds and Tornadoes was released after the submittal of the ISAR.

In the absence of updated site specific data, the SRD will be revised in Part B to reflect the 111 mph recommended 3 second peak gust wind speed.

Disposition

The BNFL response is acceptable with the following comment:

BNFL has agreed to change the wind load to bring it in conformity with the latest knowledge and provisions of the national standard (ASCE7-95) and DOE's recommendation in the cited newsletter. BNFL's use of DOE STD 1024 provisions was not acceptable as they are based on studies done over ten years ago. DOE Standards 1020 and 1023, referenced in the ISAR, stipulates that a NPH assessment will have to performed every ten years to include new information. ASCE7-95 provisions are based on new information.

Question # 39 **Status** Unacceptable

Cited Submittal Text See Section 4.

Cited Reference

Initial Safety Analysis Report, BNFL-5193-ISAR-01, Rev. 0., Section 4.2.2.4, 4.2.4.1, 4.3.1
Safety Requirements Document Volume II, Rev 1 (draft), Sections 4.1-3, 4.1-4, and 4.2-2

Evaluation Criteria

RL/REG-97-11, Revision 1, Section 6.5 - Analysis of Design Basis Events

Discussion

1. The vessels (tanks) and also the piping and piping support design criteria in the ISAR (and in the SRD) do not identify which of the categories of service these components will be designed in terms of ASME, Section VIII and ASME 31.3, respectively. Requirements for selection and certification of materials, design methods, stresses allowable, fabrication, examination, testing, QA, in-service inspection and component replacement should be specified and justified based on the required safety function to be performed by the affected components. These requirements should be considered as the basis for selecting the particular category of services in the cited codes for component design. It should be noted that the cited codes are principally meant for nuclear applications and therefore may have to be adapted to nuclear facility applications to provide the necessary design margin, reliability and quality.
2. There is an inconsistency in the seismic design basis for the DC II piping as noted in the ISAR Section 4.2.2.4 and 4.2.4.1 (Table 4-13). The former section of the ISAR stipulates the use of the UBC for seismic design whereas the latter specifies use of site specific spectra.
3. Since Section 4.3.1.11 of the ISAR stipulates API 620 and API 650 in addition to ASME as applicable codes, it is not consistent with the SRD, which only states ASME Section VIII.

Description

Please provide necessary information and justification for selecting the cited codes for vessel and piping design. Clarify applicable codes and seismic analysis methodology.

Contractor Response

1. The categories of service for these components were originally provided in response to Question 132 of the Standards Approval Package. The selection of the codes and specific categories was also addressed in that response. As a part of the redesignation of Design Class SSCs, this response is revised to reflect that Safety Design Class tanks will be designed and fabricated to ASME Section VIII.

2. As discussed in Section 4.2.2.4, the UBC provides the design methods to compute the earthquake loading. Table 4-13 provides the site specific spectra that will be used in the computation method provided in the UBC. Because both the computational method and the applicable site data are both used, the discussions in the two sections referenced is not an inconsistency.

3. The ISAR reflected the response to SAP Question 132. Based on the response to item 1, the Part B PSAR will reflect that Safety Design Class tanks will be ASME Section VIII.

Disposition

The BNFL response is unacceptable for the following reason:

BNFL has identified the process system vessels and piping as the primary barrier to hazardous or radioactive material releases. In reviewing the standards selected for design, the Regulatory Unit has considered design standards used at nuclear power facilities. The hazards associated with the failure of the primary confinement vessels and piping system at the TWRS-P facility is higher than the hazard from failure of the radioactive liquid waste system at a commercial nuclear power plant but significantly lower than the hazard from a DBA in the reactor coolant system. Selection of codes and standards for the TWRS-P design should be commensurate with the increased hazard relative to a nuclear plant radwaste system.

BNFL has stated that API 650 and API 620 will be used as the design codes for low and atmospheric vessels on the basis of information presented in Regulatory Guide 1.26 for Quality Group D. The RU believes that the selection of these standards on the basis of Quality Group D in Regulatory Guide 1.26 is inappropriate given the increased hazard of TWRS-P. Indeed, according to Section C.2.d of Regulatory Guide 1.26, systems containing radioactive material whose postulated failure would result in offsite dose (> 0.5 rem at the site boundary conservatively calculated), the Group C quality standards given in Table 1 of Reg. Guide 1.26 (i.e. ASME Section III) is applicable.

Since the failure of some of the vessels and piping in TWRS-P can have both public and worker consequences, the selection of design codes should consider other needs such as ALARA, equipment maintenance needs, and defense in depth. Also, the level of reliability needed for the component design should also be considered. Although selection of ASME Section VIII and B31.3 may be an appropriate choice in this situation, it should be noted that these codes are not generally intended for nuclear applications. As a result, certain design and operation conditions may not be adequately addressed such as design for low probability seismic events, in-service inspection among others which are better handled using other codes (e.g. ASME Section III). Thus additional features may be needed to augment Section VIII and B31.3 requirements to ensure the reliability of the subject components.

BNFL has presented a matrix of specific codes (including specific categories of service) for vessels, piping, pumps and valves in the Attachment to the response to Q132 of the Standards Approval Package. However, justification is needed for the selection of less stringent requirements for piping, pumps and valves located in-cell in contrast to those located ex-cell (i.e. Ordinary vs. Lethal category pursuant to the B31.3 code). Note that the opposite criteria have been prescribed for in-cell and ex-cell low pressure and atmospheric pressure vessels (i.e. ASME Section VIII vs. API620 and API650 codes).

Seismic design/qualification of the Safety Design Class and important to safety vessels, tanks and other components needs to be performed in accordance with DOE Standard 1020 and ASCE 4 which BNFL has included in the list of implementing standards. Use of UBC for the seismic design of these components will be acceptable only if BNFL can demonstrate that the use of UBC seismic design methodology will conform to the requirements of DOE Standard 1020 and ASCE 4.

Question # 40 **Status** Unacceptable

Cited Submittal Text

In SRD Table 4-2 Natural Phenomena Design Load for Design Class II SSCs and Table 4-14 of the ISAR Natural Phenomena, the importance factor is given as I = 1.0 for design loads for SSCs without NPH safety functions and the design loads for seismic hazards. Also, the importance factor for straight wind is given as I = 1.07.

Cited Reference

BNFL-5193-SRD-01, Rev. 0
DOE-STD-1020-94

Evaluation Criteria

RL/REG-97-11, Revision 1, Section 6.5 - Analysis of Design Basis Events

Discussion

According to UBC-97, these factors are respectively I (seismic) = 1.25 and I (wind) = 1.15 for UBC essential facilities. The contractor provided no explanation regarding use of different I factors for seismic and wind loads.

Description

Please provide justification for using the importance factor I=1.0 for DC-II SSC when the cited code provided different values.

Contractor Response

The apparent inconsistency noted in this question results from the fact that Tables 4-1 and 4-2 given in Revision 0 of the SRD (as invoked by Safety Criteria 4.1-3 and 4.1-4) do not accurately reflect the approach to NPH design being taken by BNFL. Revised criteria and tables were provided to the RU as part of the draft Revision 1 to the SRD (ref: BNFL letter 5193-97-0564 dated December 17, 1997).

In summary, the usage of Tables 4-1 and 4-2 of the SRD - as noted in the draft Revision 1 - is as follows:
· Table 4-1 is applicable to the NPH design of Safety Design Class SSCs that are required to perform a safety function as a result of a natural phenomena hazard. (See response to Question 33 for change in classification of SSCs).
· Table 4-2 is applicable to the NPH design of Safety Design Class SSCs that are not required to perform a safety function as a result of a natural phenomena hazard.

Safety Design Class SSCs that are not required to perform a safety function as a result of a NPH are non-essential facilities. Consequently, for the seismic design of such Safety Design Class SSCs, I = 1.0 in accordance with UBC-1994, Table 16-K for "Standard Occupancy Structures."

For wind design of Safety Design Class SSCs that are not required to perform a safety function as a result of a NPH, I = 1.07 in accordance with DOE-STD-1020-94, Table 3-1 for Performance Category 2 SSCs. Please note that ASCE 7-95 and DOE-STD-1020-94, not UBC, are being used for wind design.

The draft Revision 1 version of SRD Table 4-2 erroneously contains an "Essential Facilities" designation, which will be removed. A corrected version of Table 4-2 showing its appropriate applicability is attached to the response for Question 24.

Disposition

The BNFL respons is unacceptable for the following reason:

Use of two different codes/standards (i.e. UBC for seismic and ASCE7-95 for wind) to pick the lesser of the requirements instead of following the provisions of a single code or standard is unusual and unacceptable unless properly justified. Also the justification provided for the wind design is unacceptable for reasons stated in comments to BNFL response to question 24.

Question # 41

Status Acceptable

Cited Submittal Text

See below.

Cited Reference

ISAR

Evaluation Criteria

DOE/RL-96-0003, Regulatory Process, Section 3.3.2, item 6, "The adequacy of the categorization of systems, structures, and components that are important to safety."

Discussion

The terms "worker," "co-located worker," and "facility worker" are used in a confusing manner in the ISAR. Additionally, a co-located worker can be a radiation worker or a non-radiation worker, each having specific dose limits. The ISAR does not distinguish between the two.
ISAR Table 4-46 clearly differentiates between facility and co-located worker. However, the term "worker" is sometimes used to imply both facility worker and co-located worker or only facility worker thus creating confusion. See Section 4.8.2.2 where worker applies to both facility and co-located worker.

Description

Please address the above concerns related to terminology associated with worker, facility worker, and co-located worker.

Contractor Response

The Response to Question 41 has been revised:

DEFINITION OF TERMS

The term "facility worker" applies to individuals who perform work for or in conjunction with the BNFL TWRS-P Facility and who are located within the BNFL TWRS-P contractor-controlled area.

The term "co-located worker" applies to individuals performing work for or in conjunction with DOE or utilizing other Hanford Site facilities who are outside the BNFL TWRS-P contractor-controlled area but within the boundary that defines the BNFL TWRS-P location for the offsite receptor. This boundary is described in BNFL's document Radiation Exposure Standards for Workers Under Accident Conditions (RESW).

In all BNFL submittals, when the term "worker" is used without qualification, it applies to both facility workers and co-located workers either individually or collectively.

RADIATION VS. NON-RADIATION CO-LOCATED WORKERS

10 CFR 835.202(a)(1) provides an annual occupational exposure limit of 5 rem for general employees. For TWRS-P, the definition of the co-located worker (as defined above and in DOE/RL-96-0006) falls within the definition of a general employee as given in 10 CFR 835.2. Therefore, for normal operations, the corresponding exposure standard for co-located workers is 5 rem, which is the value that appears in Table 1 of DOE/RL-96-0006 and BNFL's RESW.

Within the population of co-located workers, it is recognized that there will be both radiation workers and non-radiation workers. For non-radiation workers, 10 CFR 835 provides no annual occupational exposure limit other than the 5 rem discussed above; however, 10 CFR 835.402 requires the monitoring of individual exposures if the individual is likely to receive an annual exposure of 100 mrem from normal operations.

Based on the above, BNFL's approach for the protection of co-located workers with regard to normal exposures is as follows:

· Design features and/or operational controls will be employed as needed to ensure that exposures to co-located workers from normal operations will not exceed the annual exposure standard of 5 rem and will be maintained as low as reasonably achievable.

· For those locations where annual exposures to co-located workers could exceed 100 mrem, evaluations will be performed that consider the types of workers present (radiation or non-radiation), exposure rates, expected occupancy times, and, as appropriate, dose reduction by the structures where the workers are located.

· If the evaluations indicate that the annual exposure to a non-radiation co-located worker can realistically exceed 100 mrem, appropriate actions will then be taken. These actions will depend on the specific circumstances (e.g., the number of affected individuals, expected exposures, cost of mitigating features) and may include the use of personnel monitoring, additional design features, and/or operational controls.

The above discussion relates only to annual exposures for co-located workers resulting from normal operations. For accident situations, there is no distinction between radiation and non-radiation co-located workers.

Disposition

The BNFL response is acceptable with the following comment:

As stated in the RU Evaluation Report of the BNFL SRD, RL/REG-98-01, Appendix B, "Evaluation Report - BNFL Inc. Radiation Exposure Standard for Workers Under Accident Conditions," the radiation dose standards for a co-located worker of 5 rem per year under normal events (and 5 rem per event under anticipated events), that are specified by DOE in Table 1 of DOE/RL-96-0006, include all contributors to the occupational exposure of a co-located worker. That is, the regulatory annual occupational dose limit for a co-located worker is 5 rem from all occupational exposures; the 5 rem per year dose limit for a co-located worker in Table 1 is not intended to authorize an additional 5 rem per year from BNFL facility activities for a co-located individual working at a nearby facility. Without such notation, these standards would not be in compliance with 10 CFR 835, "Occupation Radiation Protection," which is a contractually-required standard in the BNFL SRD.

Question # 42 **Status** Acceptable

Cited Submittal Text

See below.

Cited Reference

ISAR

Evaluation Criteria

DOE/RL-96-0003, Regulatory Process, Section 4.2.2, item 1, "Description of the design developed during Part A and the proposed facility operations."

Discussion

System boundaries are not adequately defined in the ISAR. A case in point is the HVAC system. On page 4-91 of the ISAR it is stated that "The C5 extract portion of the process building HVAC system is designated as Design Class II. This includes the ductwork, stack, fans, power, and control but not the filters." Such a description is incomplete. For example it does not include dampers and associated controls the malfunction of which could affect system operation and possibly worker safety.

Description

Please address these system interaction concerns and the time table to address system boundaries.

Contractor Response

The C5 extract HVAC system as described is designated as Safety Design Class with a safety function as identified in Table 4-46: "Provide for radionuclide removal and elevated release for the process cells containing the HLW and LAW receipt tanks, HLW melter feed tanks, ultra-filters and the cesium ion exchange column (Sections 4.7.2.1, 4.7.2.2, and 4.7.2.5)." SSCs which allow the Safety Design Class SSCs to perform their safety function will be similarly classified. This will occur when detailed information on these SSCs becomes available. (See response to Question 33 for change in classification of SSCs).

In the event of a failure of the listed vessels, the C5 extract will ensure facility workers are not exposed to radionuclides due to exfiltration and that co-located workers do not receive exposures in excess of stated limits (SRD 2.0-1). The failure of dampers or controls preventing the C5 extract HVAC system from performing this function will be identified in Part B as part of the HAZOPS as discussed in ISAR APPENDIX 1A, "BNFL INC. OVERALL SAFETY APPROACH," Sections A3.1, "Hazard Control Strategy Development," and A3.4 "Protection for Common Mode/Common Cause Failures."

Disposition

The BNFL response is acceptable.

Question # 43 **Status** Acceptable

Cited Submittal Text

See below.

Cited Reference

ISAR

Evaluation Criteria

DOE/RL-96-0003, Regulatory Process, Section 3.3.2, item 3, "The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled."
Section 6.6 of ISA Guidance: Adequacy of SSC Categories.

Discussion

The classification of systems in ISAR Chapter 3.0 appears to be incorrect. One such example is the Process Building HVAC system discussed in Section 4.3.6.1. Only the C5 extract system is classified as DC II. However, Tables 4-46 and 4-47 at the conclusion of Chapter 4 introduce a large number of new DC II SSCs for the protection of the facility worker for which mitigative features are required. One such system is the C3 extract system, which is classified as DC II. Other systems include the Water and Steam Systems described in Section 4.3.4 and associated controls. They are classified as neither DC I, nor DC II. However, entries in Tables 4-46 and 4-47 require detection and isolation of condensate, effluent, and cooling water streams and classify the implementing safety features as DC II. In addition, there is no discussion of safety classification of the Fuel Oil and Transfer System in Section 4.3.8.1. Should the storage tank, day tanks and transfer system which support the Emergency Diesel Generator be classified as DC II. Moreover, there is no justification for the classification of the Melter Off-gas Treatment Systems described in Section 4.3.2, which are classified as neither DC I nor DC II. Finally, the classification of the Instrumentation and Controls System does not adequately describe the DC II classification associated with the required activities described in Tables 4-46 and 4-47.

Description

Please provide the current list of SSC design classifications and associated rationale.

Contractor Response As discussed in ISAR Appendix 1A, Section 6.0, "Conformance with the Important-to-safety Concept", and summarized in Response 33, the classification of SSCs as Design Class I and II will be replaced with designation of SSCs as important to safety.

With this reclassification:

The C3 extract system is classified as important to safety as it is credited for maintaining compliance to radiological standards during normal operation. As it is not credit for accident prevention or mitigation it is not designated as Safety Design Class.

The water and steam systems are not designated as important to safety as their functions are not required for accident prevention, mitigation, or maintaining compliance to exposure standards during normal operation. Components of these systems may be identified as important to safety in Part B if they are required for achieving isolation. Components so identified will be listed in the PSAR

The 480 v diesel generator is designated as Safety Design Class as it is credited for maintaining compliance to worker exposure standards under accident conditions. The classification of the fuel oil systems will be established in Part B (and provided and provided in the PSAR) when the mission time for the diesel generator is established.

The melter off gas system is currently not classified as important to safety as its function is not required for accident prevention, mitigation, or maintaining compliance to exposure standards during normal operation.

The instrumentation and control system will have several important to safety functions. A list of the specific important to safety functions (with indication as to which are Safety Design Class) will be developed in Part B and provided in the PSAR.

Disposition The BNFL response is acceptable but subject to the following:

The classification of the melter off-gas system will be re-evaluated when the system design is more mature.. The current classification, not-important-to-safety, does not appear appropriate.

Question # 44 **Status** Unacceptable

Cited Submittal Text Design Class I Engineered Features are passive features that are not manipulated during operations. As such, no TSRs are required for these components.

Cited Reference BNFL-5193-ISAR-01, Rev. 0, Table 1-1 and Section 4.8.

Evaluation Criteria DOE/RL-96-0003, Section 3.3.2, Item 8, requires an evaluation of: AThe adequacy of the outlines of various plans, programs, and requests that will be generated and implemented in Part B."

Discussion BNFL has indicated in Table 1-1 of the ISAR that Section 4.8 of the ISAR was submitted to address the contractual requirement of DOE/RL-96-0003, Section 4.2.2, Item 12.f, to provide a Technical Safety Requirement (TSR) Plan. In Section 4.8 of the ISAR, BNFL states that TSRs will not be developed because identified Design Class I Structures, Systems, and Components (SSCs) are Apassive safety features that are not manipulated during operations." This approach is inconsistent with TSRs as described in DOE/RL-96-0006. TSRs are not limited to those associated with active SSCs. Surveillance requirements may be required for passive SSCs to periodically verify that in-service degradation has not adversely affected the SSC and to describe necessary actions should TSR surveillance criteria not be met. TSRs are also established with respect to administrative controls that are important to safety. These administrative controls may be related to the implementation of programs that are intended to prevent unanalyzed conditions from occurring or to validate specific safety analysis assumptions (e.g., an administrative control requiring verification of fissile material concentration in the facility feed stream). In summary, there is no basis in the contractual description of TSRs to limit their applicability to active SSCs.

Description How does the BNFL TSR plan implement contractual requirements related to the establishment of TSRs for passive components and administrative controls?

Contractor Response

As stated in ISAR Section 4.8, "Engineered and administrative controls credited for satisfying the radiological or chemical exposure standards for the protection of the public are the basis for Technical Safety Requirements (TSRs). Engineered and administrative controls credited for satisfying the radiological or chemical exposure standards established for the protection of the workers are the basis for LCRs."

"The selection of engineered and administrative controls is based upon the conceptual design of the facility. Additional or different features may be identified during Part B."

From Section 4.8.2.1, In addition, no TSRs are required to control process variables, design features, and operating restrictions that are the initial conditions for accident analysis that relate to public safety. Should the need for TSRs be established in Part B, they would be prepared in accordance with Safety Criterion 9.0-3 of SRD Volume II (BNFL 1997g).

From ISAR Section 4.3, Important to Safety tanks are designed, constructed, and operated in accordance with the SRD safety criteria identified in Table 4-17. In addition, Safety Design Class tanks are designed to ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels."

The HLW receipt tank has been designated as Safety Design Class. This tank will be designed, constructed, operated, maintained, and repaired in accordance with the applicable SRD criteria. For design and fabrication these criteria require compliance with ASME Section VIII. SRD Safety Criteria 7.3-7 and SRD Section 7.6, "Maintenance" establish inspection and maintenance requirements, which will include, as appropriate, tank integrity assessments as required by WAC 173-303-640. Changes to the SRD or exemptions from the Code must be submitted by BNFL Inc. and approved by the regulator. BNFL Inc. does not intend to adopt a practice of repeating SRD or code requirements in the TSRs or LCRs. A change to TSR or a code exemption require the same level of review and approval by the regulator.

If, during the development of the design, construction, or operation of the facility, it is determined that additional requirements, beyond those specified in the governing codes, are required to provide the protection of the workers, the public, or the environment, BNFL Inc. will implement the TSRs or LCRs that are necessary. In addition, if administrative controls required to protect the public or worker are identified during the project, the appropriate TSRs or LCRs will be implemented.

The passive features of Safety Design Class SSCs typically support a system that is required to be operable. The TSRs for the Safety Design Class system will have operability and surveillance requirements and appropriate compensatory measures to be taken if the system is not operable. An inoperable passive feature, that would preclude the required performance of the Safety Design Class system, would require that the Safety Design Class system be declared inoperable and the appropriate compensatory measures be taken.

In summary, passive features of SSCs are typically maintained through implementation of requirements of the governing codes, such as ASME, and no additional TSRs are required. If additional monitoring beyond code requirements, such as increased in-service inspection, is required the TSRs will be developed and submitted to the regulator. If administrative controls are

Disposition

The BNFL response is unacceptable for the following reason:

The response makes a number of statements that are not specifically related to addressing the question. For example, with respect to establishing surveillance requirements for passive components, the response states: 'passive features of Safety Design Class SSCs typically support a system required to be operable.' This statement ignores those passive facility design features that may be required to be operable to ensure adequate worker or public safety. The response is incomplete with regard to passive SSCs.

As another example, the response describes implementation of codes and standards requirements and states that these requirements will not be included in the TSRs. The reviewers agree that incorporating detailed tests and inspections (derived from codes and standards) directly in the TSRs as surveillance requirements may not be appropriate, but this issue is not directly related to question. As required by DOE/RL-96-0006, TSRs must establish an operational safety envelope for workers and the public. Establishing such an operational safety envelope requires, in part, the specification of a minimum level of SSC operability with respect to facility operating conditions. The operability of certain SSCs may be established, wholly or in part, through the performance of inspections and tests which may be derived from appropriate codes and standards. Accordingly, the successful completion of required tests and inspections within required intervals may be cited in the TSRs as a necessary demonstration of operability. Where tests and inspections are necessary to demonstrate SSC operability, the TSRs need not cite all the individual tests and inspections or technical criteria associated with performing them, but reference the approved program that does. In such cases, the TSRs establish the relationships between the defined operational safety envelope, minimum operability requirements, the test and inspection programs necessary to establish operability, and the compensatory measures that must be taken when minimum operability requirements cannot be demonstrated.

In summary, DOE/RL-96-0006 does not limit the TSRs to those associated with active SSCs and the reviewers were not able to determine from the question response if BNFL intends to establish TSRs related to passive components or administrative controls, where appropriate. This issue will be pursued during future interactions between the RU and BNFL.
identified that are necessary to assure the protection of the public, the required TSRs will be developed and submitted to the regulator.

Question # 45 **Status** Unacceptable

Cited Submittal Text Relevant text not found.

Cited Reference BNFL-5193-ISAR-01, Rev. 0, Table 1-1 and Section 3.1.
BNFL SRD, Volume II, BNFL-5193, Safety Criterion 7.4-4.

Evaluation Criteria DOE/RL-96-0003, Section 3.3.2, Item 8, requires an evaluation of: "The adequacy of the outlines of various plans, programs, and requests that will be generated and implemented in Part B."

Discussion BNFL has indicated in Table 1-1 of the ISAR that Section 3.1 of the ISAR was submitted to address the contractual requirement of DOE/RL-96-0003, Section 4.2.2, Item 12.d, to provide a Unreviewed Safety Question (USQ) Plan. The reviewers compared Section 3.1, "Configuration Management" of the ISAR to determine if a plan was outlined that would ensure conformance with requirements specified in the SRD related to USQs. Volume II of the BNFL SRD establishes requirements related to USQs in the 7-4 series of "Safety Criterion." Safety Criterion 7.4-4 establishes requirements related to actions to be taken by BNFL when new information is identified that indicates a potential inadequacy in the facility safety basis that could result in an unreviewed safety question discovery. The reviewers were unable to identify how the plan described in Section 3.1 of the ISAR implemented Safety Criterion 7.4-4.

Description How does the BNFL USQ plan implement SRD Safety Criterion 7.4-4 related to USQs that may result from new information that indicates a potential inadequacy in the facility safety basis?

Contractor Response From Section 3.1: "BNFL Inc. controls changes to the configuration of the TWRS-P Facility technical baseline relating to areas such as the Hanford Site, safety analyses, SSCs, procedures, training; and computer software. The need for changes to engineered features or administrative controls can arise from startup testing, human factors reviews, corrective actions identified by the incident investigation process, the internal oversight process and the performance of assessments, the lessons learned program, employee feedback program, performance of emergency drills and exercises, the need to improve the waste process operation, and the continuous review of worker and public safety. Facility personnel develop, review, implement, and document changes in accordance with the configuration management procedures. Implementation of these procedures ensure that a high level of protection is maintained for the workers, the public, and the environment. The unreviewed safety question (USQ) evaluation ensures that, when necessary, the proposed changes are not implemented until the appropriate regulatory approvals have been obtained."

From ISAR 3.1.4 Change Control: "A number of conditions can lead to a need to change the physical configuration, design information, or system documentation. Such changes could be triggered by, but not limited to, design changes, corrective action(s) resulting from a deficiency, and manufacturing or process changes. Changes to the documentation may also require a change to the SAR to ensure that it accurately represents the status of the TWRS-P Facility. Changes to the TWRS-P Facility physical configuration, design information, and program documentation are implemented in accordance with the configuration management process to ensure continuing integrity of the configuration."

From 3.1.4.1: "The existence of a nonconforming and degraded condition does not automatically require a USQ evaluation. However, a USQ evaluation is required if the condition or the implementation of the resolution for the condition is a change to the facility that potentially creates one of the conditions cited above."

ISAR 3.7.2 directs that: For an incident that indicates a potential inadequacy of previous safety analysis as defined in an approved safety analysis report or that indicates a possible reduction in safety margins as defined in the TSRs, actions are taken to place or maintain the facility in a safe state and a safety evaluation is performed. The completed safety evaluation is submitted to the regulator prior to removing any operational restrictions initiated in response to the incident.

Table 3-3 identifies that discovery that the facility has the potential inadequacy in the facility safety basis is classified as an "incident."

In summary: a potential inadequacy in the facility safety basis is an incident; the facility is placed in a safe state and a safety evaluation (a USQ safety evaluation) is submitted to the regulator; a need for a change (to the facility or the safety analysis) may be identified due to the information obtained in the incident investigation.

Disposition The BNFL response is unacceptable for the following reason:

There are a number of inconsistencies in the question response that make BNFL's implementation of SRD Safety Criterion 7.4-4 unclear. For example, the response summary states that for a potential inadequacy in the facility safety basis: 'a safety evaluation (a USQ evaluation) is submitted to the regulator.' This statement is inconsistent with the statement made in Section 3.1.4.1 of the ISAR (cited in the response) which states: "the existence of a nonconforming and degraded condition does not automatically require a USQ evaluation." Both of these statements are inconsistent with Section 3.7.2 of the ISAR (cited in the response).

As another example, the question response states that ISAR Table 3-3: 'identifies that discovery that the facility has the potential inadequacy in the facility safety basis is classified as an incident.' This statement is unclear and, in any event, Table 3-3 contains no such statement. In related part, the question response summary states: 'a potential inadequacy in the facility safety basis is an incident.' The reviewers were unable to confirm from a review of information in ISAR Section 3.7 and Table 3-3 related to incidents, that discovery of a potential inadequacy in the facility safety basis would necessarily be considered an 'incident.' Clarification of these issues will be necessary in future evolutions of the SAR.

Question # 46 **Status** Acceptable

Cited Submittal Text None

Cited Reference

TWRS-P Project Initial Safety Analysis Report BNFL-5193-ISAR-01, Rev. 0, Sections 1.1.1.6 (p. 1-6) and 4.2.1.5 (p. 4-59) Table 4-17

TWRS-P Project Safety Requirements Document, BNFL-5193-ISAR-01, Rev. 0, Volume II, Chapter 4, Safety Criterion 4.2-1, p.4-11

Top-Level Safety Standards and Principles Section 4.1.1.1, p. 6, "Defense in Depth"

Evaluation Criteria

DOE/RL-96-003, Regulatory Process, Section 3.3.2, Item 3: The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled. Item e, page 12 of DOE/RL-96-0003.

Discussion

There are only two qualitative references to confinement building design in the ISAR, related to pump pit enclosure buildings (Sections 1.1.1.6 and 4.2.1.5) but there is no discussion of the specific design of the entire facility's confinement system, as called for in Safety Criterion 4.2-1 of the SRD. This Safety Criterion calls for a "conservatively designed confinement system" that will "protect the worker and public from undue risk of releases such that the radiological and chemical exposure standards of Safety Criteria 2.0-1 and/or 2.0-2 are not exceeded.

During a BNFL system briefing to the DOE/RU on January 9, 1998, it was stated that DC-1 systems will be single failure proof.

Description

1. Please describe the features and design philosophy for the BNFL confinement building structures and whether they will be designated Design Class I or II.
2. How is the single failure proof criterion integrated into the DC-1, HLW Receipt Tank design?

Contractor Response

1. See response provided for Question 1.

2. The single failure criterion is not applied to passive components such as the HLW receipt tank.

Disposition

The BNFL response is acceptable.

Question # 47 **Status** Acceptable

Cited Submittal Text

"In the TWRS-P Project processing facility, all potentially hazardous operations are performed in steel-lined cells with reinforced concrete walls a minimum thickness of 1 m (3.3 ft.). This robust design provides barriers that can withstand the impact of the most probable aircraft missiles. This will be discussed in greater detail in the PSAR."

Cited Reference

TWRS-P Project Initial Safety Analysis Report BNFL-5193-ISAR-01, Rev. 0, Table 4-28, page 4-127 through 4-129

Top-Level Safety Standards and Principles Section 4.3.6.1 sets the Contractual standard for Security insofar as its impact on safety regulation

The Regulatory Process, Section 3.3.2 (The adequacy of the selection and definition of design-basis events for the proposed facilities), item 4, p. 6.

The ISA Review Guide provides Review Consideration 1 - Initiating Conditions :

"The Reviewers will determine if the Contractor has identified the appropriate initiating conditions for the design-basis events. Table 1.3 from the AIChE Guidelines provides a list of possible initiating events, propagating events, risk reduction factors (controls), and incident outcomes. The initiating events can originate from process upsets, management system failures, human errors, and external events (e.g., high winds, floods). Propagating events include equipment failure, ignition sources, management system failure, [emphasis added] human error, domino effects (other containment failures or material releases), and external conditions. Risk reduction factors include control/operator responses, safety system responses, mitigation system responses, and emergency plan responses, etc. Incident outcomes include information not related to initiating conditions."

TWRS-P Project Hazard Analysis Report BNFL-5193-HAR-01, Rev. 0, Section 2.1.3 (Nearby Facilities and Transportation), page 2-7 through 2-14.

Evaluation Criteria

DOE/RL-96-003, Regulatory Process, Section 3.3.2, Item 3: The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled.

Discussion

Table 4-28 of the ISAR does not evidence initiating conditions for the selection of design basis events that includes:

- Management systems
- External events involving the impacts of nearby accidents, and vandalism/sabotage

In a telephone conference between R. Cullen (BNFL) and J. Boudreau (DOE/RU) on January 29, 1998, it was explained that management system failures would be part of the evaluation of human factors during Part B.

While the BNFL Safeguards and Security Plan identifies the material in the TWRS-P facility as "attractiveness level E" (lowest level from the perspective of fissile material), the plant could be a target for terrorists or radiological sabotage. Standard 5 of the Contract calls for a safeguards and security program that addresses, among other things, physical protection. Therefore, acts of vandalism and sabotage will not be considered in the review of design basis events in the ISAR, but rather will be assessed during Part B in coordination with DOE's Safeguards and Security review of the project.

Section 2.1.3.2 of the HAR discusses the transportation-related activities in the proximity of the TWRS-P plant (vehicular, rail, aircraft) and Section 2.1.3.3 describes nearby industries. Section 2.1.3.4 describes the evaluation of accidents involving nearby facilities and transportation, and implies that cells provide the protection to Design Class I and II systems. However, it is not made clear either in the HAR or ISAR why these events were not included in the selection of Design Basis Events.

Description

1. Please explain how these initiators were considered in the definition of those bounding events identified in Table 4-28 and in the selection of Design Basis Events.
2. Please confirm that the impact of management system failures on design basis event selection will be addressed as indicated above.

Contractor Response

1) Table 4-28 is derived from screening the events from the PHA, which considered only process hazards. Preliminary analysis of the effect of external events, including transportation, nearby facilities, industry and military facilities were assessed in HAR Section 2.1.3.4. The effects of motor vehicle and train accidents involving hazardous releases, and of accidents at nearby nuclear facilities and industry present the issue of plant habitability, and placing the process in a safe state in case of the need for evacuation. This assessment will be included in the PSAR during Part B.

The preliminary assessment of the potential for an explosion on a transportation route indicated that "explosive shipment on roads and railroads not controlled by DOE does not represent a threat to the TWRS-P facility." Assessment of the potential for aircraft crash into the facility indicated the estimated annual frequency to be 4.5 x 10-6 per year. This is greater than the 10-6 per year threshold given by DOE-STD-3014-96. As stated in Section 2.1.3.4 of the HAR, an assessment of the expected frequency that the aircraft crash will damage Design Class I or II systems is to be included in the PSAR.

2) The binning process involved a qualitative assessment of the frequency and the consequences of several events to support the selection of the bounding events. The qualitative assessment of the probability of an event included the frequency of the initiating event. The initiating event could be the result of a mechanistic failure or a management system failure. However, once the probability of the event was assessed, the actual initiating event had no impact on the results of the accident analysis. As the project evolves, more information will be available in support of qualitative assessment of the probability of an event. This information will include the potential impact of management systems. Therefore, the design basis event selection process currently reflects the impact of management system failures and design basis event selection will continue to be evaluated as more detailed information becomes available as the project design matures.

ISAR Section 3.5.2.3: "The design process includes human factors design analyses that encompass design criteria such as system performance criteria, safety, cost, training, scheduling, environmental considerations, physical layout, warning features, communications, and other factors that serve to minimize errors of omission and commission and to ensure that the operator is able to respond to situations in which human response is required. Human factors principles are applied at the TWRS-P Facility to reduce the potential of hazardous situations caused or exacerbated by human error and to enhance the potential of appropriate and timely human actions to mitigate events. Appropriate and timely response to adverse conditions or events provide defense-in-depth to the workers, the public, and the environment" confirms that the impact of management system failures on design basis event initiation and selection will continue during Part B.

Disposition

The BNFL response is acceptable but subject to the following:

With regard to external events, the BNFL response states that "The effects of motor vehicle and train accidents involving hazardous releases and of accidents at nearby nuclear facilities and industry present the issue of plant habitability, and placing the process in a safe state in case of the need for evacuation. This assessment will be included in the PSAR during part B."

The HAR states that "Accidents that might occur on State Highway 240, such as explosions or toxic chemical releases, are judged to present a negligible risk to the TWRS-P Facility because of the distance between the facility and the highway."

The ISA Review Guide states that the Reviewer should "Assess design-basis events for identifying or evaluating effectiveness of controls and for establishing design requirements for SSCs important-to-safety"

Given that the preliminary assessment of the risk (probability and consequence) of events that would require evacuation, the response is adequate. However, since the response indicates that evacuation of the plant may be required during such events, SSC design to quickly place the facility in a safe shutdown state may be necessary. The response is therefore acceptable, provided that the issue of SSC design related to prompt, safe plant shutdown is treated in the PSAR.

With regard to aircraft accidents, the response goes on to state "Assessment of the potential for aircraft crash into the facility indicated the estimated annual frequency to be 4.5 X 10-6 per year. This is greater than the 10-6 per year threshold given by DOE-STD-3014-96. As stated in Section 2.1.3.4 of the HAR, an assessment of the expected frequency that the aircraft crash will damage design class I or II systems is to be included in the PSAR."

The RU will ascertain that the PSAR addresses: motor vehicle and train accident related hazards; aircraft crash related hazards; and a plant design that permits prompt evacuation of operating personnel when necessary without creating an additional safety hazard.

Question # 48 **Status** Acceptable

Cited Submittal Text In Section 6.1 of the HAR and Section 4, page 4-126 of the ISAR.

Cited Reference BNFL Tank Waste Remediation System Privatization Project Hazard Analysis Report, BNFL-5193-HAR-01, Rev. 0, Section 6.1

Evaluation Criteria DOE/RL-96-0003, Regulatory Process, Section 3.3.2, Item 3, "The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled."

Discussion The Contractor states that because the HAR assumed some mitigation in some of its fault schedule events all of the postulated events would be re-evaluated in the ISAR, regardless of the consequence ranking, i.e., 1, 2, 3, or 4. However, on page 4-126 of the ISAR the Contractor states that only those events with public consequence rankings of 2, 3, or 4 were evaluated for the ISAR.

Description Please evaluate events with consequence rankings of 1 or provide justification why this commitment is no longer necessary.

Contractor Response ISAR Sections 4.6.2.2 and 4.7.1.1 are incorrect in stating that PHA events assigned consequence category 2, 3 or 4 only were considered in selecting events for further consideration by accident analysis. All PHA events, including the category 1 events, were examined for those that could result in high consequences if unmitigated. Table 4-28 includes some events that were assigned public consequence category 1 on the basis of mitigated consequences (e. g., Event 3, Event 29, and Event 47). These events were judged to have the potential for significant consequences if mitigating features were not credited and therefore were included in the accident selection process.

The majority of events that were assigned consequence category 1 by the hazard evaluation team fell into one of the following categories:

1) Small release quantities or low radionuclide or toxic chemical content
2) Direct radiation potentially affecting the facility worker, but because of distance and shielding, having no affect outside the facility.
3) Non-radiological and non-toxicological hazards affecting the facility worker, for example, dropped crane loads falling on a worker or eye injury from a laser. The majority of these are covered by occupational safety standards.
4) Events that could affect the operability of the facility (process shutdown) but with no direct impact on the worker or the public.

Disposition The BNFL response is acceptable.

Question # 49 **Status** Acceptable

Cited Submittal Text None

Cited Reference ISAR Section 4.7.2.10

Evaluation Criteria "Guidance for the Review of TWRS Privatization Contractor Initial Safety Assessment Submittal Package," RL/REG 97-11, Rev. 1, December 1997.
Section 6.5, "Acceptability of the results of the analysis," Section 6.8, "Initial Safety Analysis Report," and Review consideration 5, "Hydrology," in Section 6.1, "Design, Operations, and Site Description."

Discussion The radiation dose consequences from the radioactivity released in the design basis earthquake are computed based only on airborne pathways. For completeness in evaluating long-term exposures, other pathways should be considered.

Description Why are pathways other than airborne, e.g., groundwater, not considered?

Contractor Response The first paragraph of ISAR Section 4.6.3 summarizes the rationale for considering only the inhalation exposure pathway for the radiological releases. It is consistent with the approach used for other Hanford facilities and the Savannah River DWPF. (References: WHC-SD-WM-SARR-016, Rev. 2, Tank Waste Compositions and Atmospheric Dispersion Coefficients for use in Safety Analysis Consequence Assessments, August 1996; and WSRC-SA-6, Rev. 16, Final Safety Analysis Report Savannah River Site Defense Waste Processing Facility, Volume 6, March, 1997).

Emergency response, i.e., evacuation and interdiction, are credited for preventing uptake through ingestion and direct shine from redeposition of radioactive material on the ground. Because the TWRS-P source terms do not contain significant quantities of short-lived noble gases or iodines, submersion doses from the plume as it passes over the hypothetical receptor are orders of magnitude lower than the inhalation doses. Calculated submersion doses from the accidents with source terms that are primarily cesium were a factor of 1000 lower than inhalation doses for the public, and a factor of 104 lower than inhalation doses for the co-located worker.

Hanford soil has a high capacity for holdup of ionic species, particularly cesium. Past modeling of postulated large liquid releases to the soil column from the Hanford tank farms showed that short term exposure to populations downriver through the river pathway are insignificant. Public exposure from fallout into the river from airborne releases, and subsequent transport downriver, would be mitigated by interdiction through emergency response actions.

Disposition The BNFL response is acceptable but subject to the following:

The BNFL response addressed the concerns. However, this matter will be evaluated in more detail in the future and additional analysis or data may be requested.

Question # 50 **Status** Unacceptable

Cited Submittal Text None

Cited Reference ISAR Section 4.7, "Results of the Integrated Safety Analysis"

Evaluation Criteria "Guidance for the Review of TWRS Privatization Contractor Initial Safety Assessment Submittal Package," RL/REG 97-11, Rev. 1, December 1997.
Section 6.5, "Acceptability of the Results of the Analysis."

Discussion Conversion from Bq to Sv in discussions of radionuclide inventories and source terms as represented in Sv may cause confusion during subsequent public review. Additionally, representing source terms in radiation dose consequences is incomplete and inconsistent with the analytical methods to quantify the health effects from radiation exposures.

Description

Please justify the use of this conversion in the ISAR.

Contractor Response

Radionuclide dose effects have been compared on a common scale using sievert or rem. These units permit standardizing the measures of health effects from all radionuclides. In Table 1 of DOE/RL-96-0006, the standards (accident analysis acceptance criteria) are presented in unit of dose (rem). Therefore to be consistent, the results of the accident analysis are presented in sieverts (rem).

The underlying assumption of this is the assumption of the linear relationship between dose and potential cancer effects. Performing a screening of potential accidents of consequence to the worker and public by comparing the radiation unit of becqueral or the curies could obfuscate a serious accident because the dose effect of a curies or a becqueral can vary considerably across a spectrum of radionuclides in an inventory of a material-at-risk. For example, in the HLW there is 87 times as much cesium-137 as americium-241, yet the americium-241 contributes 90 percent of the dose. However, in retrospect, the potential for confusion identified above could have been alleviated by normalizing the results to the dominant accent. Then the ranking could have been provided as decimal fractions of 1.0.

The determination of consequence in dose as defined by the so called "five factor equation" in DOE-HDBK-3010-94 which was used in the accident analysis is commutative. The arrangement of the factors in this equation does not change the results. The results of the screening are carried to completion in the accident analysis, Section 4.7 for those accidents that are found to be bounding in the screening of the class of events and the material-at-risk. There is no value added by performing detailed accident analysis on each of the accidents and the results of the screening are rigorous enough to identify the bounding accidents.

Disposition

The BNFL response is not acceptable for the following reason:

The response is technically inaccurate. The presentation method of radionuclide inventory in the BNFL analysis is chosen for convenience sake-not because it is commutative in the "five-factor" formula in DOE-HDBK-3010-94, and is irrelevant to the latent cancer effects. Dose conversion factors in EPA-520 alone are sufficient to assess the potential health effects through various pathways for same quantities of different radionuclides.

While results are not impacted, presentation of the methods to compute the radiation dose consequences should be technically correct. For instance, the time for one person to inhale the amount of 10.5 m3 as discussed in Event 2 on p. 4-131 is in excess of 8 hours in the conservative calculation with the breathing rate of 3.47´10-4 s/m3. The receptor is postulated to breathe a volume of pure liquid in this case at the location of the postulated rupture. Hence, the inhalation dose equivalent, 50-year dose commitment, of 1.1´108 Sv (1.1´1010 rem) from an accidental release of 6.1´1015 Bq of cesium is a significant misrepresentation of health effects.
This matter will be resolved during evaluations of TWRS related health effects in the future.

Question # 51

Status Acceptable

Cited Submittal Text

None

Cited Reference

ISAR Section 4.7.2.x.5 "Mitigating Design Features"; Section 4.8.1.2, "Design Class II Engineered Features"

Evaluation Criteria

"Guidance for the Review of TWRS Privatization Contractor Initial Safety Assessment Submittal Package," RL/REG 97-11, Rev. 1, December 1997.
Section 6.3, "Hazards Assessment and Control," and Section 6.6, "Adequacy of SSC categories."

Discussion

General information on the ventilation system identified to mitigate the consequences of the postulated accidents between Sections 4.7.2 and 4.8.2.2 is inconsistent or lacking. Only the C5 extract system is identified as the engineered features to mitigate the consequences in Section 4.8.2.2. Section 4.7.2.x.5 identifies "features of the ventilation system that assure routing through the release to the stack".

Description

Provide the following general design parameters:
(1) air changes per hour intended for the facility,
(2) the design pressure in inches w.g. or in Pa intended for those areas identified as C5.
(3) BNFL design philosophy related to active DC-II systems. C5 fans shown in the Technical Report, 98-RU-B-010, Drwg. 0 BE 1614700 & 1633480, are described with less detail than C2 or C3 fans. There is lack of balance in description of the systems related to safety. Is there component redundancy in the C5 ventilation system?
(4) Since the C5 extract system is identified as the mitigating feature in Section 4.7.2.10, "Design Basis Earthquake," is the system Seismic Category 1?
(5) Is the supporting electrical power systems or ventilation control as indicated on p. 4-152 Seismic Category I?
(6) Please address how BNFL intends to separate those portions of the HVAC system identified as DC-II from the remaining portions of the system or the building, i.e., controls discussed in Section 4.7.2.6.5 and lower pressure in the contaminated areas will be maintained to mitigate the consequences as analyzed in the ISAR.
(7) In Section 4.8.1.2, item 2) on p. 4-182 and the discussion on p. 4-152 appear to designate the entire HVAC system as DC-II to prevent "pressure reversals." Please clarify.

Contractor Response

1. Air changes per hour intended for the facility.

The main objective of the ventilation systems, for the Process Building, is to support the confinement of sources of contamination, principally by air flows and pressure differentials designed to promote air flow from areas of lesser contamination potential to areas of greater contamination potential.

The ventilation of nuclear facilities is generally based on full fresh air once through systems. Consequently the energy costs associated with treating the supply air (heating, cooling, humidification) and the facility costs associated with filtering the exhaust air are relatively high. Similarly, the radioactive waste arising from contaminated HEPA filters and the costs for filter disposal increase with increasing air flow through the system. Therefore, the design of ventilation systems for nuclear facility should attempt to minimize the total air flow through the system from inlet to discharge.

Past BNFL Sellafield experience has shown that where minimum air change rates, for a given classification of area, have been used as a basis for ventilation design, this has resulted in higher air flows and a bigger ventilation plant than is necessary to meet design objectives. Air change rates; therefore, are now only used at the concept design stage for the purpose of allocating space for the ventilation plant.

In meeting the design objectives the corresponding design flows give the following approximate air change rates for the LAW and HLW Facility.

AREA	Air change/hr
C5 Pre-Treatment Cells	<1 overall
C5 HLW Line	2 to 8
C5 LAW Line	1 to 16
C3 Areas	2 to 10
C2 Areas (via C2 Extract)	<1 to 8

2. The design pressure in inches w.g. or in Pa intended for those areas identified as C5. The design pressure for C5 areas is a negative 250 to 300 Pa. The pressure difference between C5 and C3 areas is 250 Pa.

3. In a letter on February 9, 1998 to Dr. Clark Gibbs (5193-98-0038), BNFL provided additional information pertaining to the Heating, Ventilation, and Air Conditioning system. In this package, Drawing O BE 1614708 depicts the C5 extract. In its current design, the C5 system has two sets

Disposition

The BNFL response is acceptable.

Question # 52 **Status** Acceptable

Cited Submittal Text

None

Cited Reference

ISAR Section 4.7.2.10.5, Last Paragraph

Evaluation Criteria "Guidance for the Review of TWRS Privatization Contractor Initial Safety Assessment Submittal Package," RL/REG 97-11, Rev. 1, December 1997.
Section 6.6, "Adequacy of SSC Categories"

Discussion It is stated that "tanks and their connections should be designed to prevent release of the gas under the forces provided by the earthquake."

Description Please state the design classification of these tanks and clarify "should" and "may" in the text.

Contractor Response The last paragraph of ISAR Section 4.6.2.10.5 should be replaced with the following:

The ammonia tank and the nitric acid storage tank in the cold chemical storage area have a Safety Design Class confinement function. The tanks and their connections are designed to prevent the release of the contents under the forces provided by the earthquake, shown in ISAR Table 4-14.

Disposition The BNFL response is acceptable.

Question # 53 **Status** Unacceptable

Cited Submittal Text None

Cited Reference BNFL Initial Safety Analysis Report, BNFL-5193-ISAR-01, Rev.0, Chapter 5.0, "Radiation Safety," Chapter 9.0, "Emergency Management," Chapter 10, "Environmental Protection," Appendix 5, "Radiation Protection Program Outline," Chapter 5B, "Environmental Radiation Protection Program Outline."

Evaluation Criteria DOE/RL-96-0003, Section 3.3.2.1, "The degree to which the Contractor's proposed safety-related activities are being performed or can be performed in compliance with the approved SRD."
DOE/RL-96-0003, Section 3.3.2.2, "The degree to which the Contractor's proposed safety-related activities are being performed or can be performed in compliance with the approved ISMP."
DOE/RL-96-0003, Section 3.3.2.8, "The adequacy of the outlines of various plans, programs, and requests that will be generated and implemented in Part B."

Discussion DOE/RL-96-0006, Section 4.1.6.1, Quality Assurance Application states, "Quality assurance and quality control should be applied throughout all phases and to all activities associated with the facility as part of a comprehensive system to ensure with high confidence that all items delivered and services and tasks performed meet required standards." DOE/RL-96-0006, Section 4.1.6.3, Operational Quality Assurance Programs states, "Operational quality assurance and control programs should be established by the Contractor to assist in ensuring satisfactory performance in facility activities important to safety."

There are no stated commitments to Quality Assurance/Quality Control within the Radiation Protection Program, Environmental Radiation Protection Program, or the Emergency Preparedness Program. There is only an implied commitment to QA/QC for external dosimetry in the commitment to NVLAP/DOELAP accreditation (BNFL-5193-ISAR-01, Rev.0, Section 5.9, External Exposure).

Description What are the BNFL commitments to QA/QC at the programmatic levels of radiation protection, environmental radiation protection, and emergency preparedness?

Contractor Response The objective of the BNFL Inc. TWRS-P Quality Assurance Program (QAP), as stated in Section 3.3 of the ISAR, is to establish planned and systematic actions necessary to provide adequate confidence that all activities affecting quality of the contract are satisfactorily conducted to meet radiological, nuclear, and safety requirements.

Because of the overarching nature of the project QAP, it was not felt that each program mentioned in DOE/RL-96-0006 subject to QAP requirements had to be reiterated.

Revisions of the QAP to be developed during Part B of the contract will provide for the accomplishment of activities affecting quality under suitable controlled conditions. These activities include radiation protection, environmental radiation protection, and emergency preparedness, as well as design, safety analysis, and many others.

The QAP is revised for different phases of the project as follows:

- prior to start of construction
- prior to start of operation
- prior to start of deactivation

(Table S4-1 of the contract)

Revisions of the QAP will be developed and submitted to DOE-RU for review and approval at the earliest time consistent wit the project schedule. The QAP and revisions thereof will include consideration of technical aspects of the activities affecting quality compatible with each phase of the Part B.

Disposition

The BNFL response is unacceptable for the following reason:

The scope and content of the TWRS-P radiation protection program, environmental radiation protection program, and emergency preparedness program are going to be the same regardless of the final facility design. They are clearly safety related documents with regards to personnel, public, and the environment, and as such, both the program documents and their implementing procedures must be controlled documents per the QAP. Personnel must be trained and qualified, instruments must be calibrated and maintained, data collection and reporting must have QC requirements, and programs must be audited.

To say that QA/QC requirements for these programs will be delineated during Part B indicates to the reviewers that the contractor does not understand the fundamental basis or the safety significance of these programs.
There are numerous inferences to QA/QC within the BNFL SRD, ISMP, and ISAR for the TWRS-P radiation protection program, environmental radiation protection program, and emergency preparedness program, however, BNFL does not commit to these QA/QC requirements within these various program documents. Examples of these inferences are listed below.

BNFL's SRD Volume II, (BNFL-5193-SRD-01, Rev. 0)

Safety Criterion 7.2-1 commits to training and qualification of technical support personnel.

Safety Criterion 7.2-2 commits to training for individuals relied upon to maintain the facility in a safe manner.

Safety Criterion 7.3-3 commits to training and qualification of personnel.

Safety Criterion 7.3-5 commits to approved instructions, procedures, or other appropriate means for use in performing work. A commitment is also made to calibrate and maintain equipment used for process monitoring or data collection.

Safety Criterion 7.3-9 and 7.3-10 commit to assessments and audits.

BNFL's ISMP (BNFL-5193-ISP-01, Rev. 0)

Section 1.3.13, "All activities that may affect safety of workers or the public are performed in accordance with step-by-step instruction provided in procedures."

Section 3.5, "Personnel training and qualification and procedure development credited for worker and public safety during facility operation are developed in accordance with the requirements of the QAP." "The QAP is applied to the Emergency Management Program in the areas of training and qualification of emergency response team members, assessment of the program effectiveness, and records documentation."

Section 8.0, Table 8-1 provides a partial listing of safety management records controlled by the QAP. Documents listed in the table include the Radiation Protection Plan, the Emergency Plan, calibration and testing data, radiation protection and contamination control records, radiation work permits, and environmental release and monitoring records.

BNFL's ISAR (BNFL-5193-ISAR-01, Rev. 0)

Section 3.3, "The TWRS-P Project Quality Assurance Program (QAP) ensures that the design, procurement, construction, testing, inspection, operation, maintenance, and deactivation activities conform to safety requirements." And "Adherence to the TWRS-P Project QAP ensures the following: 3) Hazards to the workers, public, and environment are minimized."

Section 3.9, "All TWRS-P Project activities that affect safety are carried out in accordance with formally documented manuals, procedures, or instructions."

This issue will be pursued during future interactions between the RU and BNFL.

Question # 54 **Status** Acceptable

Cited Submittal Text

The "Remarks" column of Table 3-2 ("Application of Quality Assurance Program Requirements for QL-1, QL-2, and QL-3 Structures, Systems, and Components"), page 3-39, contains the following statements:

1. (a) For Criterion 6., Design, Bullet 9: "Independent design verification is not required for QL-2."

(b) For Criterion 7., Procurement, Bullet 3: "Supplier monitoring is not mandatory during the procurement process for QL-2."

2. Section 3.6.5, page 3-53, states: "Performance monitoring is conducted on an annual basis by a multi-disciplinary team consisting of environmental protection, industrial safety, process safety, health physics, and the nuclear safety and regulatory staff.... Performance monitoring ensures that high standards of performance are maintained in at least the following areas: ...."

Cited Reference

1. BNFL Initial Safety Analysis Report (BNFL-5193-ISAR-01), Rev. 0, January 12, 1998

2. Letter 98-RU-0015, January 16, 1998, D.C. Gibbs to M.J. Bullock, "Initial Safety Evaluation Completeness and Adequacy Review Results: Contract DE-AC06-RL13308"

Evaluation Criteria

The degree to which the Contractor's proposed safety-related activities are being performed or can be performed in compliance with the approved ISMP. (DOE/RL-96-0003, Section 3.3.2, Paragraph (2))

Discussion

1. As stated under item 3. of the Enclosure to cited reference 2., "Commitments made in response to RU package Questions 116 and 117 to delete statements from ISMP Table 1-4 ... were not reflected in ISAR Table 3-2 ...."

Representatives from BNFL called the RU reviewer on January 15, 1998 to discuss this issue. They made the following points:

(a) The revised ISMP Table 1-4 (i.e., revised to reflect the BNFL responses to the RU questions) and ISAR Table 3-2 should have been identical.

(b) ISAR Table 3-2 was incorrect; the statements in the "Remarks" column of this table regarding QL-2 should have been deleted.

(c) They were at a loss to explain why the two tables were not compatible.

2. Regulatory Unit SAP Question Number 138 requested an explanation of the rationale for not including a member of the TWRS-P QA organization on the team that will conduct performance monitoring and why the QA program was not one of the areas to be monitored. In its response to Question Number 138, BNFL committed to including: (a) a member of the TWRS-P QA organization on the team that will conduct performance monitoring and (b) the QA program as one of the areas to be monitored.

It does not appear that BNFL's commitments in response to Regulatory Unit Question Number 138 have been reflected in ISAR Section 3.6.5 in that this section neither identifies someone from the TWRS-P QA organization as a member on the team that will conduct performance monitoring nor does it include the QA program as one of the areas to be monitored.

The problems outlined above raise concerns within the Regulatory Unit regarding the extent to which BNFL is providing or can provide adequate attention to detail during critical aspects of planning, developing, and implementing the TWRS-P Project QA program.

Description

1. Please explain why the commitments made by BNFL in response to Regulatory Unit Question Numbers 116, 117, and 138 on the BNFL Standards Approval Package were not reflected in the ISAR.

2. Please explain why the BNFL initially submitted assessment of ISAR compliance to the SRD and the ISMP (Attachment A to BNFL Letter 5193-98-0006, January 12, 1998) did not identify that these commitments had not been met.

3. Please describe the measures BNFL will take during Part B of the contract to ensure that adequate attention to detail will be consistently and effectively provided during the planning, development, and implementation of the TWRS-P Project QA program.

Contractor Response

1. The commitments made by BNFL Inc. are intended to be fulfilled as stated in the response to RU SAP questions, numbers 116, 117, and 138.

2. Table 3-2 in the ISAR was developed from Table 1-4 in the ISMP and is not a direct copy ("cut and paste"), because the language was being converted from passive to active voice, as well as agreed changes being incorporated in the remarks column. Two times the author failed to incorporate changes in the remarks column.

3. During Part B of the contract, the control system will be improved and documented to provide for:
- assignment of responsibility for preparing, reviewing, and issuing documents,
- review of documents for adequacy, completeness, compliance, and correctness prior to approval and issuance.

Disposition

The BNFL response is acceptable but subject to the following:

1. The BNFL response to part 1. of this question indicates that BNFL intends to fulfill the commitments stated in the BNFL response to RU SAP question numbers 116, 117, and 138. This response is acceptable since it reiterates the BNFL commitments made previously to the Regulatory Unit.

2. The BNFL response to part 2. of this question indicates the reasons why previously-committed-to changes in ISMP Table 1-4 were not reflected in Table 3-2 of the ISAR. This explanation is reasonable and the response is therefore considered acceptable.

3. The BNFL response to part 3. of this question indicates that the control system for preparing, reviewing, and issuing documents will be improved and documented during Part B of the contract. This response is partially acceptable. However, it is not sufficiently comprehensive to address the Regulatory Unit's concern regarding the extent to which BNFL is providing or can provide adequate attention to detail during critical aspects of planning, developing, and implementing the TWRS-P Project QA program. As a result, the Regulatory Unit's concern in this area will be addressed in subsequent contractor submittals, including the BNFL Part B QAP and QA Implementation Plan to be issued to DOE 60 days prior to Part B contract award.

Question # 55

Status Acceptable

Cited Submittal Text

Section 3.2 of the ISAR regarding maintenance.

From the ISMP cited reference, page 3-25: "During the design phase, ... Reliability targets are assigned to SSCs only when a quantitative value has been credited for the reliability of an SSC in safety analysis."

Cited Reference

BNFL-5193-ISAR-01, Rev. 0, BNFL Initial Safety Analysis Report (ISAR), Table 1-1

BNFL-5193-ISAR-01, Rev 0, Section 4.2.3.2;

BNFL-5193-TR-01, Rev 0, BNFL Technical Report, Section 6.3.1; and

BNFL-5193-ISP-01, Rev.0, Integrated Safety Management Plan, Section 3.1

Evaluation Criteria

DOE/RL-96-0003, Section 4.2.2, Contractor Input, Item 12) h) requires the Contractor to submit an outline of their Maintenance Implementation Plan.

DOE/RL-96-0003, Section 4.2.2 Contractor Input, Item 9 requires the contractor to document "The Contractor's evaluation of constructability, operability, reliability, availability, maintainability, and inspectability."

DOE/RL-96-0003, Section 4.2.2 Contractor Input, Item 3 requires "An assessment of compliance to the approved SRD and the ISMP"

DOE/RL-96-0006, Section 4.2.7.1, Reliability, states: "Reliability targets should be assigned to structures, systems, and components or functions important to safety. The targets should be consistent with the roles of the structures, systems, and components or functions in different accident conditions. Provisions should be made for appropriate testing and inspection of structures, systems, and components for which reliability targets have been set.

Discussion

The Safety Requirements Document (SRD), BNFL-5193-SRD-01, Rev. 0, Volume II, section 7.6 provided the safety criteria (S.C.) for maintenance for the TWRS-P that are generally consistent with DOE Orders and the draft maintenance rule. Table 1-1 of the ISAR states that section 3.2 of the ISAR contains the outline of the Maintenance Implementation Plan (MIP). Some of the topics that the S.C. committed to address in the MIP do not appear to be included in the "outline" of the MIP provided in section 3.2 of the ISAR. The missing topics are listed below:

Items (6) and (9) from S.C. 7.6-3
"The maintenance program shall clearly define:

(6) Provisions for identifying and evaluating possible component, system design, occupational safety and health, or other relevant problems and implementation of a self-assessment program;

(9) Quantitative reliability target values for systems and components to start or run, when such values are credited in safety analysis."

Items (10) and (13) from S.C. 7.6-4
"The maintenance program shall address each of the following elements:

(10) Material receipt, inspection, handling, storage, retrieving, and issuance;

(13) Documented facility condition inspection."

With respect to item (9) of S.C. 7.6-3, the ISAR and the technical report do not appear to address the establishment of reliability targets to those structures, systems and components (SSCs) important to safety. Attachment E to the SRD (BNFL-5193-SRD-01, Rev. 0) does not cite a safety criterion for DOE/RL-96-0006, 4.2.7.1. The cited text from the ISMP apparently provides the only contractor reference to the manner in which the top-level principle related to reliability targets will be addressed. However, the cited ISMP text provides insufficient information to determine if reliability targets, including associated testing and inspection provisions, have been established.

Description

a) Will the MIP address the missing elements identified above, as well as those discussed in Section 3.2 of the ISAR?

b) If the missing elements will not be included in the MIP, where will they be addressed?

Contractor Response

As required by SRD safety criterion 7.6-1, BNFL Inc. will develop and implement a maintenance program. This will require compliance with the other criteria of SRD Section 7.6. However, each attribute listed in SRD 7.6 may not be addressed in a formal maintenance program. For example, material receipt and inspection is addressed in the Quality Assurance Section of the ISAR.

Regarding the specific attributes reference by the reviewer:

(6) From ISAR 3.2.1: "Written maintenance performance criteria and a trending process are used to monitor the effectiveness of the maintenance organization and program and the performance of Design Class I and II SSCs. Problems and incidents are analyzed and trended to identify important deficiencies or trends adverse to safety, such as equipment or material problems, procedure or training deficiencies, or personnel errors. Lessons learned from deficiencies are communicated to waste process industry sources and conversely, information from lessons learned at BNFL facilities and other industry sites are evaluated for applicability to the TWRS-P Facility. (Refer to Section 3.7, "Incident Investigations," for further detail.) As with all other department supervisors and managers, maintenance supervisors routinely monitor work in progress to ensure that maintenance activities are conducted in accordance with facility policies and procedures. This behavior is a practice imposed by BNFL Inc. corporate policies (e.g., PC006-H-001.1, Workplace Safety). Supervisors stress industrial safety and radiological protection practices; the quality of

workmanship, material, and parts; and the effective use of procedures. (The FSAR will provide a detailed description of the maintenance organization, roles, and responsibilities.)" The above reference to "Design Class I and II SSCs" will be replaced by "Important to Safety SSCs". Self assessments are also discussed in Section 3.6.

(9) As stated in ISMP 3.13: "Reliability targets are assigned to SSCs only when a quantitative value has been credited for the reliability of an SSC in safety analysis." To date, no quantified reliability target values for systems or components to start or run have been credited in the safety analysis. The arbitrary assignment of reliability targets without the benefit of an overall framework of risk identification and improvement to provide focus, can be an exercise that materially adds small improvement. On of the expected outputs of the overall risk assessment is a list of equipment for which specific reliability is needed.

(10) From 3.3.4.4 Work Processes. "TWRS-P Project work processes include, but are not limited to, quality-affecting activities involving designing, fabricating, procuring, constructing, handling, shipping, storing, cleaning, assembling, inspecting, installing and testing, operations, making modifications, performing maintenance and repair deactivating items. Details of the work control process from initiation of a work request through post-review ensure personnel safety, equipment protection, and facility configuration (including content and controls for a work package) are established."

From 3.3.4.6: "Records that an item furnished by a supplier conforms to code, regulation, or contract procurement requirements are completed before installation or implementation. Methods established for the acceptance of an item furnished by suppliers consist of one or more of the following:

1) Supplier certification and release (Certificate of Conformance)
2) Source verification or inspection
3) Receiving inspection
4) Acceptance testing
5) Post-installation testing."

(13) From 3.11.2.3 Operator Inspection Tours. "Operators conduct periodic inspections of their accessible areas of responsibility to ensure that the status of those areas and their equipment is known. These tours are conducted at scheduled times. During the tours, equipment is inspected to ensure that it is operating properly or, in the case of standby equipment, that it is fully operable. The tour activities include, but are not limited to, local and port inspection, log keeping, troubleshooting, reporting deficiencies, responding to alarms, and housekeeping. The results of operator tours are documented on roundsheets."

From 3.11.2.4 Log Sheets. "Log sheets are used to uniformly record the status and condition of equipment and work areas. Use of operator roundsheets and control area log sheets provide operators guidance on the extent of equipment and areas inspections and a means to record events and status of the inspected areas and equipment."

c) How will the missing elements be integrated into the Maintenance Program?

d) With respect to the use of reliability targets, are they currently established, and if not, when will they be?

Disposition

The BNFL response is acceptable.

Question # 56 — Status: Acceptable

Cited Submittal Text See below

Cited Reference ISAR

Evaluation Criteria DOE/RL-96-0003, Regulatory Process, Section 3.3.2, item 6, "The adequacy of the categorization of systems, structures, and components that are important to safety."

Discussion Inadequate Description of Mitigative Features

There appear to be some misleading and incorrect statements in the ISAR regarding mitigating features. For example, on page 126 of the ISAR the statement is made that "Table 4-28 identifies those SSCs that ensure worker protection is provided." This implies a list of mitigative features. Such mitigative features are not provided. Instead what is being provided is a list of events for which worker protection should be provided. It is anticipated that the mitigative features will include adequate SSC classification and other design features/functions. A list of safety functions, which should be implemented to protect the co-located and facility worker, is provided in ISAR Table 4-46 and Table 4-47. Again though there is no description of how these safety functions will be implemented.

Description

1. What are the mitigative features which implement the safety functions listed in ISAR Table 4-46 and Table 4-47 for the protection of the worker (co-located and facility)?
2. What are the mitigative features that protect the worker and public for events caused by NPH?

Contractor Response

The reference to Table 4-28 on page 4-126 is incorrect. The reference should be to Tables 4-46 and 4-47. Sheet 2 of Table 4-46 lists the "Prevention and Mitigation Features Required Primarily for the Protection of the Facility Worker."

The SSCs listed in column 1 of ISAR Tables 4-46 and 4-47 are the preventive or mitigative features that implement the safety functions listed in column 2 of those tables. For instance, for the first item, the LAW tanks will be designed to standards that ensure that they perform the function of maintaining confinement of their contents (prevent failure) during the DBE for Safety Design Class SSCs. Providing a tank that will not fail under the loading of the design basis earthquake is a design function that will be performed in Part B. The specific features of each SSC listed in the tables that are essential to performing the safety function and therefore require Safety Design Class design are developed as design progresses.

The same development applies to all the SSCs listed in column 1 of Tables 4-46 and 4-47.

Disposition

The BNFL response is acceptable,

Question # 57 **Status** Acceptable

Cited Submittal Text

See below. Note: This question is related to Perez-1.

Cited Reference

ISAR

Evaluation Criteria

DOE/RL-96-0003, Regulatory Process, Section 3.3.2, item 7, "Adequacy of the projected safety basis for the facility and its operation."
The J documents require risk-informed decision making on all approval actions.
DOE/RL-96-0006.
ISAR Review Consideration 8 - Safety Analysis and Results (Safety Goals).

Discussion

The ISAR Approach is Predominantly Deterministic

Even though ISAR talks at length of frequencies and risks, (see for example Table 4-24), BNFL's approach in the ISAR is predominantly deterministic. That is, when it comes to addressing specific accidents, BNFL only includes serious and major consequence events (see Table 4-28). It is from this list that the final selection of the bounding events is made. It is difficult to make a evaluate design without understanding if low consequence, high frequency events could affect the selected bounding events.

Description

Please explain BNFL's plan to use risk-informed decision making in its approach to overall plant safety.

Contractor Response

Low consequence, high frequency events do not impact the bounding events which are based upon the highest consequences without regard to frequency. However, low consequence, high frequency events can cause pose hazards to workers or the public and contribute to the overall risk of the facility. As such, these events must be controlled.

The philosophy of BNFL Inc. in controlling these events is to ensure the accident risk goals stated in the SRD, based on the Top-Level Standards, are achieved. However, the level of design detail necessary to adequately define the initiators and fault paths as well as the preventive and mitigative features of these low consequence high frequency events is not present in the conceptual design stage. These events will be further evaluated during the HAZOPS and HAZOP

IIs performed during Part B consistent with the identification of defense-in-depth items and selection of additional worker protection features.

BNFL Inc. will perform risk analyses as necessary to demonstrate these goals are met (see ISAR Appendix 1A Section 2.6 Confirmation That The Risk From Accidents is Acceptable). See also the response to Question 56.

Disposition The BNFL response is acceptable.

Question # 58 **Status** Acceptable

Cited Submittal Text See below

Cited Reference HAR, ISAR

Evaluation Criteria DOE/RL-96-0003, Regulatory Process, Section 3.3.2, item 3, "The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled."

Discussion There is no indication that the events listed in HAR Table 4-8 "Off-normal Events at Waste Vitrification Facilities" have been included in the ISAR.

Description Please explain why events listed in HAR Table 4-8, which have occurred in waste vitrification facilities, were not included for consideration in the ISAR.

Contractor Response The activities described in Sections 4.4.1 and 4.4.2 of the Hazard Analysis Report were prepared as part of the hazard identification process. A study of the hazard and accident analyses for facilities similar to the TWRS-P facility is reported in HAR Section 4.4.1. Reports of off-normal events and incidents at other facilities were examined for those that could have applicability to the TWRS-P facility. The results of this exercise are reported in HAR Section 4.4.2.

Prior to the commencement of PHA studies on TWRS-P concept design, safety cases for similar plants were examined for hazardous event listings as part of the preparatory work. Events such as shield door failures, ultrafiltration blockages, backflow of activity to an operating area, gross spillages of nitric acid were noted and brought up during the PHA studies to ensure that they were adequately addressed by the proposed design. Subsequent design decisions have been based on findings of the PHA, including those originating in the consideration of events from other waste vitrification facilities.

These activities provided a check on the comprehensiveness of the events examined by the PHA. Table 4-8 includes a column that indicates where similar incidents to those reported at other facilities were addressed in the PHA. The conclusion of the exercise for off-normal events at other facilities was that all had been adequately addressed in the PHA.

The PHA, which includes events from other waste vitrification facilities, provided the basis for selection of accident scenarios for analysis in ISAR section 4.7 and controls for worker safety in ISAR section 4.8.

Disposition The BNFL response is acceptable.

Question # 59 **Status** Acceptable

Cited Submittal Text None

Cited Reference TWRS-P Project Initial Safety Analysis Report, BNFL-5193-ISAR-01, Rev. 0, Chapter 6.

Preliminary Criticality Safety Statement for TWRS, TWRS/CR1, Rev. 0.

TWRSP Technical Report, BNFL-5193-TR-01, Rev. 0.

Evaluation Criteria

4.1.2 The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled. Item E, page 12 of DOE/RL-96-0003.

Discussion

The ISAR states that the upper limit for concentration of solids by ultrafiltration of the HLW feed is 3x. However, this claim does not appear consistent with the supporting reference, "Preliminary Criticality Safety Statement for TWRS." That document states that during normal operation, ultrafiltration will increase the concentration of solids in the process stream by around a factor of 3 suggesting that the upper limit for normal operations could be higher.

Description

What is the uncertainty in the solids concentration due to ultrafiltration during normal operation? Please provide the technical bases for this uncertainty.

Contractor Response

The uncertainty in the solids concentration in the ultrafilitration in normal operation are the uncertainty in the measurements and the uncertainty in the instrumentation monitoring the ultrafiltration operation. More information on the waste characteristics is required to specify the ultrafiltration sampling system, the solids concentration analytical method and the instrumentation to measure volume percent solids. There is an uncertainty associated with the sampling system, once it is specified, in its capability to obtain a representative sample. Likewise the analytical technique has an inherent uncertainty that is controlled and measured by the QA program. The solids concentration instrumentation is manufactured to provide results within a specified level of uncertainty. It too early in the design of development to have the uncertainty data to answer this question.

Disposition

The BNFL response is acceptable but subject to the following:

BNFL responded that, "it is too early in the design development to have the uncertainty data to answer this question." This issue will be pursued during later stages of the facility design. Specifically, BNFL will be requested to determine an upper bound on the increase in concentration due to ultra-filtration.

Question # 60 **Status** Acceptable

Cited Submittal Text None

Cited Reference

TWRS-P Project Initial Safety Analysis Report, BNFL-5193-ISAR-01, Rev. 0, Chapter 6.
Preliminary Criticality Safety Statement for TWRS, TWRS/CR1, Rev. 0.
TWRSP Technical Report, BNFL-5193-TR-01, Rev. 0.

Evaluation Criteria

4.1.2 The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled. Item E, page 12 of DOE/RL-96-0003.

Discussion

The ISAR states that the upper limit for concentration of solids by ultrafiltration of the HLW feed is 3x during normal operation. The "Preliminary Criticality Safety Statement for TWRS" states that during normal operation, ultrafiltration will increase the concentration of solids in the process stream by around a factor of 3. Credible accident conditions affecting ultrafiltration which might lead to overconcentration are not discussed in the ISAR or the "Preliminary Criticality Safety Statement For TWRS".

Description

1. What accident conditions in ultrafiltration could lead to an overconcentration of solids.
2. What is the upper bound on overconcentration during such accidents?

Contractor Response

The ISAR does not address overconcentration as an accident condition because it was not determined in the HAR to be an accident. Overconcentration is addressed in the HAR as a shielding concern (pg 5-43) and as an operability problem if the solids should plug the transfer line (pg 5-46), but at this time, filtration data - porosity, compressibility and particulate size distribution - required to determine if overconcentration is problem should all controls fail remain to be developed. Ultrafilters are susceptible to fine particulates, which comprise significant fraction of tank solid waste, becoming trapped in the filter pores limiting a further increase in solids concentration. If the design requirement is a filter cake high in solids and a low in moisture, the ultrafilter is not the filter of choice because of the previously described blinding of the filter that occurs as the solids content of the ultrafilter slurry increases.

BNFL has identified development work to determine ultrafiltration performance under TWRS-P process conditions in the Technical & Development Support to the TWRS-P Design, K0104_077_PRC, (December 1997). This will establish credible slurry concentrations (overconcentration) beyond which the ultrafilter will fail to perform, thus giving rise to an operability problem.

BNFL is also committed to re-evaluation of the criticality assessment as the design develops in part B. This is in line with its safety approach of re-evaluation and assessment of hazards in greater detail during part B. If the overconcentration (or any other) scenario gives rise to a credible potential for criticality then criticality controls backed up by a criticality program will be defined.

Disposition

The BNFL response is acceptable but subject to the following:

BNFL responded that, " Answering the reviewer's question is an action item that requires ultrafilteration development work and data." This issue will be pursued during later stages of the facility design. Specifically BNFL will be requested to provide an assessment of ultra-filtration events that include as an upper bound a possible over-concentration of fissile material.

Question # 61 **Status** Acceptable

Cited Submittal Text None

Cited Reference

TWRS-P Project Initial Safety Analysis Report, BNFL-5193-ISAR-01, Rev. 0, Chapter 6.

Preliminary Criticality Safety Statement for TWRS, TWRS/CR1, Rev. 0.

TWRSP Technical Report, BNFL-5193-TR-01, Rev. 0.

Evaluation Criteria

4.1.2 The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled. Item E, page 12 of DOE/RL-96-0003.

Discussion

In response to SRD review question 23, it was stated that, "Even under worst case conditions, the concentrations from Envelope D material were conservatively estimated as 1.3 g/l Pu equivalent. This appears to contradict the claim in section 3 of the "Preliminary Criticality Safety Statement for TWRS" that the equivalent Pu concentration cannot exceed roughly .6 g/l after ultrafiltration (which is cited as the worst case concentration).

Description

Please explain the discrepancy between the worst case concentrations cited in the SRD review question responses and the ISAR submittal.

Contractor Response

The response to SAP review question 23 is in error. It incorrectly cites the preliminary criticality safety evaluation as giving a worst case Pu equivalent concentration of 1.3 g/l. The referenced report gives 0.6 g/l for this value.

Disposition

The BNFL response is acceptable.

Question # 62 **Status** Acceptable

Cited Submittal Text None

Cited Reference

TWRS-P Project Initial Safety Analysis Report, BNFL-5193-ISAR-01, Rev. 0, Chapter 6.

Preliminary Criticality Safety Statement for TWRS, TWRS/CR1, Rev. 0.

TWRSP Technical Report, BNFL-5193-TR-01, Rev. 0.

Evaluation Criteria

4.1.2 The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled. Item E, page 12 of DOE/RL-96-0003.

Discussion In response to SRD review question 24, it was stated that the criticality safety assessment to be presented in the ISAR chapter 6, "covered both normal and fault conditions; the fault conditions considered were overconcentration, settling out, and drying out". However, the ISAR and supporting documents do no contain any discussion of credible accident conditions.

Description 1. What are the credible accident conditions in the TWRS-P HLW process which could result in settling or dry-out?
2. What are the resulting increases in Pu concentrations due to these accidents?

Contractor Response Overconcentration scenarios identified in the HAR are : Event 0/6 - Fissile material accumulation; 2100/0 - Overconcentration of liquor; 1/0 - Overconcentration of entrained solids; and 1/45, loss of agitation. From this list the off-normal condition analyzed in the ISAR was the ultrafiltration event, the overconcentration of entrained solids. This resulted in a three fold concentration increase.

Analyses for future design stages will include HAZOPs. The quantification of potential waste concentration from settling, dryout and overconcentration scenarios will be reviewed in analysis for to the PSAR to determine the largest concentration factor.

Disposition The BNFL response is acceptable but subject to the following:

BNFL responded that, "The quantification of potential waste concentration from settling, dryout and overconcentration scenarios will be reviewed in analysis for the PSAR to determine the largest concentration factor." The PSAR will be reviewed for incorporation of a detailed and quantitative assessment of fissile material over-concentration accidents.

Question # 63 **Status** Acceptable

Cited Submittal Text "In the TWRS-P Project processing facility, all potentially hazardous operations are performed in steel-lined cells with reinforced concrete walls a minimum thickness of 1 m (3.3 ft.). This robust design provides barriers that can withstand the impact of the most probable aircraft missiles. This will be discussed in greater detail in the PSAR."

Cited Reference TWRS-P Project Initial Safety Analysis Report BNFL-5193-ISAR-01, Rev. 0, Table 4-28, page 4-127 through 4-129

Top-Level Safety Standards and Principles Section 4.3.6.1 sets the contractual standard for Security insofar as its impact on safety regulation

The Regulatory Process, Section 3.3.2 (The adequacy of the selection and definition of design-basis events for the proposed facilities), item 4, p. 6.

The ISA Review Guide provides Review Consideration 1 - Initiating Conditions :

"The Reviewers will determine if the Contractor has identified the appropriate initiating conditions for the design-basis events. Table 1.3 from the AIChE Guidelines provides a list of possible initiating events, propagating events, risk reduction factors (controls), and incident outcomes. The initiating events can originate from process upsets, management system failures, [emphasis added] human errors, and external events (e.g., high winds, floods). Propagating events include equipment failure, ignition sources, management system failure, [emphasis added] human error, domino effects (other containment failures or material releases), and external conditions [emphasis added]. Risk reduction factors include control/operator responses, safety system responses, mitigation system responses, and emergency plan responses, etc. Incident outcomes include information not related to initiating conditions."

TWRS-P Project Hazard Analysis Report BNFL-5193-HAR-01, Rev. 0, Section 2.1.3 (Nearby Facilities and Transportation), page 2-7 through 2-14.

Evaluation Criteria DOE/RL-96-0003, Regulatory Process, Section 3.3.2, Item 3: The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled. Item e, page 12 of DOE/RL-96-0003.

Discussion Table 4-28 of the ISAR does not evidence initiating conditions for the selection of design basis events that includes:

- Management systems
- External events involving the impacts of nearby accidents, and vandalism/sabotage

In a telephone conference between R. Cullen (BNFL) and J. Boudreau (DOE/RU) on January 29, 1998, it was explained that management system failures would be part of the evaluation of human factors during Part B.

While the BNFL Safeguards and Security Plan identifies the material in the TWRS-P facility as "attractiveness level E" (lowest level from the perspective of fissile material), the plant could be a target for terrorists or radiological sabotage. Standard 5 of the Contract calls for a safeguards and security program that addresses, among other things, physical protection. Therefore, acts of vandalism and sabotage will not be considered in the review of design basis events in the ISAR, but rather will be assessed during Part B in coordination with DOE's Safeguards and Security review of the project.

In ISAR Section 4.7, "Results of the Integrated Safety Analyses," there is a list of process-related accidents and their analyses. Other facility and man-made events are not included, such as loss of utilities, plane crashes, nearby highway accidents, chemical/fuel fires (e.g., diesel generator tanks), and adjacent nuclear facilities (e.g., a possible, second TWRS-P facility). Intra-facility accidents (e.g., shield doors/flasks) and combination ("domino") accidents are not included (apart from one earthquake scenario). Inclusion of analyses on these accidents may affect the DC categorization of SSCs, and could result in additional, DC I SSCs.

Section 2.1.3.2 of the HAR discusses the transportation-related activities in the proximity of the TWRS-P plant (vehicular, rail, aircraft) and Section 2.1.3.3 describes nearby industries. Section 2.1.3.4 describes the evaluation of accidents involving nearby facilities and transportation, and implies that cells provide the protection to Design Class I and II systems. However, it is not made clear either in the HAR or ISAR why these events were not included in the selection of Design Basis Events.

Description Please explain how external events were considered in the definition of those bounding events identified in Table 4-28 and in the selection of Design Basis Events. Either provide the results of these additional accident analyses or provide a rationale for why they are not needed. Also, please confirm that the impact of management system failures on design basis event selection will be addressed as indicated above.

Contractor Response External events (effects of nearby facilities, transport accidents, aircraft crash, other industries) were evaluated in Section 2.1.3.4 (Page 2-10ff) of the HAR for hazard potential. The potential was deemed to be negligible based on qualitative factors such as TWRS-P siting distance from significant hazard potential (e.g., roads, rail carrying dangerous materials) backed up by evaluation of these distances using NRC Reg Guide 1.91. It is acknowledged that further work on aircraft crash potential is to be carried out in Part B using DOE-STD-3014-96. Tornadoes are not considered to be a credible event for the Hanford site. Treatment of straight wind (and wind borne missiles) is to follow the DOE-STD-1023. The response to Q 47 provides additional detail on our treatment of external events. It is considered that sufficient detail, appropriate to the Part A design, has been given on the treatment of external events. Further, more explicit treatment will take place as the design matures.

This has meant that external events, other than the seismic event (Section 4.7.1.2.1, Page 4-130 of the ISAR) were not considered as bounding events.

Further to the telecon between Cullen (BNFL) and Boudreau (DOE/RU) of 1/29, it can be confirmed that the potential for management system failures as contributors to human error (fault) scenarios will be covered as part of the detailed human factors treatment of the facility in Part B.

Disposition The BNFL response is acceptable.

Question # 64 **Status** Acceptable

Cited Submittal Text None.

Cited Reference TWRS-P Project Initial Safety Analysis Report BNFL-5193-ISAR-01, Rev. 0, Section 3.7.3, Categorization of Incidents, p. 3-57

Evaluation Criteria 3.3.2: The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled. Item 3, page 6 of DOE/RL-96-0003.

Discussion

On page 3-57 of ISAR Section 3.7.3, "Categorization of Incidents," there is a listing of examples of unusual and off-normal incidents that are identified. Within the group of incidents identified as "Facility Condition" there is a subgroup identified as "Facility in a degraded or unanalyzed condition." The unusual incident that initiates an action is described as stated below. "Any event or condition during operation or shutdown that results in the facility being seriously degraded or being in an unanalyzed condition that significantly compromises safety of the public, or outside the design basis for the protection of the public." How this would be applied, for example, in the case of the occurrence of a seismic event is not clear since the incident investigation appears to be initiated by the impacts on the facility that can only be determined by already having taken some investigative actions.

Description

Please clarify how off-normal incidents such as seismic events can initiate actions prior to investigation of the event.

Contractor Response

Operators are required (and trained) to take prompt and appropriate actions in response to off-normal events or conditions. These actions taken are not based on the initiation or results of the incident investigation process. The training will address operator response to events necessary to maintain or restore the safe condition of the facility. Procedures will be developed to provide the operator guidance on the appropriate actions to be taken.

As further clarification, a seismic event would require prompt operator response to off-normal indications or operations. However, a seismic event and the facility response is an analyzed event for the TWRS-P Facility.

Disposition

The BNFL response is acceptable.

Question # 65 **Status**

Cited Submittal Text

None.

Cited Reference

BNFL Initial Safety Analysis Report, BNFL-5193-ISAR-01, Rev. 0, Chapter 5.0, "Radiation Safety."
BNFL SRD Safety Criterion 5.2-1 and 5.2-2.

Evaluation Criteria

DOE/RL-96-0003, Section 3.3.2.1, "The degree to which the Contractor's proposed safety-related activities are being performed or can be performed in compliance with the approved SRD."
DOE/RL-96-0003, Section 3.3.2.2, "The degree to which the Contractor's proposed safety-related activities are being performed or can be performed in compliance with the approved ISMP."
DOE/RL-96-0003, Section 3.3.2.8, "The adequacy of the outlines of various plans, programs, and requests that will be generated and implemented in Part B."

Discussion

There are inconsistencies between the selected standard NRC Regulatory Guide 8.8 (Safety Criterion 5.2-1 and 5.2-2) and SRD Safety Criterion 5.2-1 and 5.2-2.

In the contractor's Safety Requirements Document (SRD), BNFL-5193-SRD-01, Rev. 0, Volume II, Safety Criterion (SC) 5.2-1 and SC 5.2-2, NRC Regulatory Guide (RG) 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations will be as Low as is Reasonably Achievable (ALARA)," is listed as an implementing standard.

The regulatory positions of RG 8.8 contain policy, design, and operational considerations related to ALARA that are more detailed and thorough (and sometimes different) than the commitments in the contractor's ISAR Section 5.0. (It is noted that RG 8.8 has not been referenced in ISAR, Rev. 0, Sec. 13.0, "References.") Examples of differences between RG 8.8 and ISAR, Rev. 0, Sec. 5.0, include:

-In RG 8.8 (page 8.8-4), it is stated that policy should address maintaining annual collective occupation doses (man-rem) at levels that are ALARA. Section 5.1 of the ISAR reads as if only individual doses are considered in ALARA goals.

-RG 8.8 (page 8.8-4), provides regulatory positions on the organization, personnel, and responsibilities applicable to all phases of facility life (i.e., planning, design, construction, operation, maintenance, and decommissioning). This includes the plant manager, ALARA Committee, and the radiation protection manager (RPM). For the planning and design phase, organizational requirements and responsibilities in RG 8.8 are not consistent with the same information specified by the contractor in ISAR Sections 2.0 and 5.2. (For example, on page 2-10 of ISAR Section

2.1.1.2, it is stated that the "radiation protection organization," headed by the RPM, apparently exists only during the operations phase. But, on page 2-4 of ISAR Section 2.1.1.1 it is indicated that the "architect engineering organization" oversees implementation of the design requirements of 10 CFR 835, including assuring that personnel exposure is ALARA. This seems to be inconsistent with RG 8.8)

There are additional Reg Guide 8.8 positions that are not addressed in the ISAR or do not have placeholder in the ISAR, and it is not clear if BNFL intends to fill in the missing information later. The contractor's ISAR should not conflict with the SRD commitment to follow RG 8.8 as it relates to policy, design, and operational considerations that demonstrate doses will be ALARA. The contractor should revise the ISAR to include commitments that do not conflict with the regulatory positions in RG 8.8.

Description

1. What are BNFL's commitments to the implementation of NRC Regulatory Guide 8.8 elements?
2. Please explain the apparent discrepancies between RG 8.8 and the ISAR.

Contractor Response

1. BNFL Inc. committed to the use of RG 8.8 for radiation protection during design activities. See SRD Section 5.2 Occupational Radiation Protection Design, SC 5.2-1 and 5.2-2. As such, elements of RG 8.8 applicable to other phases of the TWRS-P lifecycle, e.g., operations, maintenance, and decommissioning, have not been committed to within the SRD.

As a part of the ISA submittal, BNFL performed an assessment of implementation of the SRD and at this time recommended that the Safety Criteria of Section 5.2 be deleted. This recommendation is repeated here:

"These Safety Criteria {SC 5.2-1 through 5.2-4} were provided as a "placeholder" ensuring that design objectives provided in 10 CFR 835 would not be omitted due to an approved Radiation Protection Program not being in place. In subsequent negotiations with DOE it was agreed that a phased RPP developed and submitted for approval in stages, depending upon the hazard addressed and the applicable regulatory driver(s). The initial RPP will encompass design requirements during the facility design phase. See ISAR Chapter 5.0 and Appendix 5A 2.0.

Disposition

The BNFL response is acceptable with the following comment:

The BNFL response is acceptable because the RU will have the opportunity to review the initial RPP that will encompass ALARA design requirements prior to the commencement of significant facility design. The RU will also have the opportunity to review the draft RPP and ALARA programs prior to construction and again to review the final program documents prior to commencing operations. BNFL does not need to specify subordinate standards until the development of the draft documents.

Based upon this agreement and the commitment compliance with 10 CFR 835, these Safety Criteria are appropriately reflected and should be removed from the SRD."

2. Also see response provided above.

Section 5.1 of the ISAR states that both personal radiation exposure shall be maintained ALARA and that radiation exposure of the workforce be controlled so radiation exposures are maintained well below regulatory limits and so that radiation exposure is balanced against commensurate benefit.

Section 2.1.1.1 identifies the organization overseeing the implementation of ALARA for design. Assignment of the Radiation Protection responsibilities to the AE firm during design assures that activities relative to design such as those noted in RG 8.8 page 8.8-5 (e.g., experience obtained from work at similar facilities is considered and reflected within the work of the designer, A/E, and builder and include R\PM (a) Participating in Design reviews for facilities.....) are included in the design and construction portion of the TWRS-P lifecycle. Additionally, all significant design activities will be conducted in accordance with the RU approved RPP.

Question # 66 **Status** Unacceptable

Cited Submittal Text None.

Cited Reference BNFL-5193-ISAR-01, Rev 0, Section 5.8, "Contamination Control."

Evaluation Criteria

DOE/RL-96-0006, Section 4.2.1.1, "The facility should be designed for a set of events such as: normal operations, including anticipated operational occurrences, maintenance, and testing: external events; and postulated accidents."

DOE/RL-96-0005, Section 3.3.2, "The adequacy with which the hazards, including process hazards, attendant to the contractor's proposed activities have been assessed and controlled."

Discussion

Although there is a discussion on the principles used for mitigating and controlling airborne contaminated areas in the facility, there is no identification of expected contaminated zones and the hazards associated with airborne contamination in normally or routinely occupied (e.g., sampling) work spaces. Spaces which may house processes which are designed to retain the radioactivity during normal operations, can become permanently contaminated as a result of process upsets.

Description

1. Have those spaces, which will be contaminated, and/or be "on-mask" status after start-up been defined?
2. Has a hazards analysis been performed relative to the facility worker for these airborne contaminated spaces where routine or periodic operations, surveillance, testing, sampling or maintenance are performed?

Contractor Response

Details on contamination zoning of the facility are presented in the ISAR, chapter 5, e.g., Table 5-5 (Page 5-7) indicates control requirements for C1-C5. Contamination zone layouts with indications of barrier controls between C1/C2 and C2/C3 are given in BNFL drawings O BE 1634045 - 1634062. These are available for inspection at the BNFL offices. This zoning is not expected to change as a result of facility operations. If, as the result of an abnormal event, additional local contamination occurs (in a C3 area for example) then a temporary reclassification (to C4) together with the required controls (Table 5-5) would be carried out under local procedures to the approved Radiation Protection Program. Classification to the original scheme (as currently proposed) would take place after clean up operations were demonstrated to have been successful.

A hazards analysis has not yet been performed on facility worker operations such as maintenance operations or sampling. This is a Part B activity to support the emergence of detailed operating and maintenance instructions. The creation of these instructions is only possible when the detailed design has been finalized.

Disposition

The BNFL response is unacceptable for the following reason:

The response to the second part of the question is unacceptable from a worker's safety standpoint. The definition of where and when facility workers will have routine or periodic work assignments within contaminated workspaces must be defined very early in the design phase. As an alternative, a clear statement that there will be no routine or periodic work activities in work spaces requiring respiratory protection, is acceptable. This is design input information that must be used to minimize worker's radiological exposure. Design features, such as remote sampling systems (instead of contact sampling) and remote video cameras (instead of visual inspection) would be expected from this information. The RU will look for these design features during Part B of the facility development.

Question # 67 **Status** Acceptable

Cited Submittal Text

Not cited

Cited Reference

Section 4.3, BNFL-5193-ISAR-01 "Process Description"

Section 3.2, BNFL-5193-TR-01, "Pretreatment"

Evaluation Criteria

DOE/RL-96-0006, Section 4.2.1.1, " The facility should be designed for a set of events such as: normal operations, including anticipated operational occurrences, maintenance, and testing; external events; and postulated accidents."

Discussion

Emergency maintenance may be required on equipment, piping or vessels within the pretreatment cell, prior to or in parallel with the loss of transfer capabilities to the vitrification facilities. The process descriptions and the applicable drawings do not show any capability to jettison quantities of highly radioactive materials for emergency maintenance activities or as a result of a process upset, or from an abnormal or emergency event. In general, there is an inadequate discussion of expected abnormal or emergency modes of operations.

Description

1. Has an abnormal or emergency operation been postulated that would require rapid emptying of the contents in the feed pretreatment vessels?
2. If such an operational condition is plausible, have provisions been made in the design (e.g., return route back to AP-106)?

Contractor Response

1. The HAR list a wide variety of abnormal operations. The specifics of each operation have not been postulated at this time. The traditional BNFL design approach doesn't require extensive maintenance operations. The vessels and piping are designed for the life of the facility. If analysis shows the potential for loss of equipment during the expected processing campaign, a redundant system is added.

If an emergency arises, the equipment in question is flushed until the maintenance requirements are met. BNFL has used this approach with failed equipment at Sellafield (i.e., Magnox dissolver). As noted on all of the PFDs, vessels and the cells have spray rings and ejectors for emptying solutions.

2. Regardless of the need for emergency transfers, the facility has the capability to return solution to 241-AP-106 or any other DST. Two lines transfer solution from 241-AP-106 to the facility. As described in Section 4.3.1.1, Waste Receipt, of the ISAR; both lines can either send or receive solution from the DOE.

In addition, two lines provide for the transfer of HLW feed to the facility.

Disposition

The BNFL response is acceptable with the following comment:
BNFL's response, that if required by emergency conditions, the inventory can be returned to the feed receiver tank, provides the basis for an acceptable disposition.

Question # 68 **Status** Unacceptable

Cited Submittal Text

TR, Table 2-1 and Table 2-2, Chemical Composition of Waste Envelopes
TR, Appendix D, Process Flowsheets
HAR, Section 4.4.1, Comparison to HAR from Other Facilities
ISAR, Section, 1.2.4, Type, Quantity and Form of Waste Material

Cited Reference

BNFL-5193-HAR-01, Rev. 0, Hazards Analysis Report (HAR)
BNFL-5193-TR-01, Rev. 0, Technical Report (TR)
BNFL-5193-ISA-01, Rev. 0, Initial Safety Analysis Report (ISAR)

Evaluation Criteria

DOE/RL-96-0003. Regulatory Process, Section 3.3.2, Item 3, "The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled."

Discussion

The chemical composition of the waste envelopes indicates the presence of significant total organic carbon (TOC). Neither the HAR, TR or the ISAR provide information or discussion as to the nature of this material (light organic such as NPH; heavy organic such as TBP, hydrolysis by-products, D2EHPA, HEDTA, or grease; limited to solubility levels, or potential for entrained, immiscible organic phase, or adsorbed by the solids). The referenced section of the HAR discounts the significance of volatile organics in the waste streams. The referenced section of the ISAR states that Envelope C contains organically complexed strontium and TRU that requires removal.

The process flowsheets indicate that the bulk TOC constituents are transported through pretreatment to the melter, which implies that the TOC vapor pressure is low and the TOC is not steam stripped during evaporation. The flowsheet also implies that the TOC is soluble and not adsorbed with the solids. The actual separation of organically complexed Sr and TRU for Envelope C is not apparent in the flowsheet. The glass composition has no carbon content which implies that the TOC is decomposed to gaseous oxides of carbon during melting. However, there are no carbon compounds quantified in the melter off-gas. Where did it go?

The issue of TOC constituents are important to the RU if there is potential for transport of immiscible organic, above solubility limits, from the underground storage tanks. Accumulation of a light organic phase in the feed tank or elsewhere in the process introduces a hazard that has not been analyzed. The transport of heavy immiscible organic downstream to IX could have negative impact on radioisotope separation and the ability to meet LAW specifications.

Description

1. Characterize the nature and potential hazards associated with the TOC species.
2. Describe the need for detection and/or control of TOC compounds in the feed tanks and elsewhere in the process.
3. Discuss the experience base BNFL has with processing TOC and the sensitivity the process unit operations have to immiscible organics above the solubility limits.
4. Do these TOC constituents have any environmental permit implications?

Contractor Response

The TWRS Privatization contract specification 7, Low-Activity Waste Envelope Definition, states the maximum total organic carbon (TOC) content per mole of sodium in the Envelopes A, B, and C feeds is 6E-02, 6E-02, and 5E-01, respectively. Contract specification 7 does not state whether or not the TOC is present as a separate organic phase or is miscible in the low-activity waste (LAW) feeds.

One tank at the Hanford site, tank 241-C-103, is known to contain a separate organic phase (degraded tributyl phosphate). Several additional single shell tanks (SSTs) in C tank farm are suspected to contain a separate organic phase. This information has been documented in several reports issued by Hanford site contractors; e.g., WHC-SD-WM-ES-384. The U.S. Department of Energy has indicated that SSTs that contain a separate organic phase are not candidates for Phase I B processing in the BNFL waste treatment facility (HNF-SD-WM-SP-012, rev. 0A). The U.S. Department of Energy has not detected a separate organic phase in waste samples obtained from double-shell tanks (DSTs).

The reasons that a separate organic phase is not present in the DST wastes is related to the specific organic chemicals that were added to the wastes stored in the DSTs. The origins of the organic carbon present in the LAW feeds are primarily sugar from the PUREX sugar de-nitration process, ethylene diaminetetraacetic acid (EDTA) and trisodium hydroxyethylene diaminetriacetate acid (HEDTA) used in cesium ion exchange processing at B Plant. These organic chemicals are soluble in the aqueous waste. Tributyl phosphate (TBP) and normal paraffin hydrocarbon (NPH) chemicals were used in the solvent extraction processes used at PUREX, B Plant, U Plant, and the Plutonium Reclamation Facility. TBP and NPH were not discharged to the DSTs. If present in sufficient concentration, these organic chemicals would not be soluble in the LAW (i.e., would form a separate phase).

The U.S. Department of Energy analyzed the LAW samples provided to BNFL during Part A of the TWRS Privatization contract for semi-volatile organic compounds (e.g., TBP, NPH) and organic

Disposition

The BNFL response is unacceptable for the following reason:

The BNFL response illustrates that sampling of the UGS tanks confirms the presence of immiscible organic in some locations, and process knowledge implies the likelihood of immiscible organic in other locations. BNFL, however, "does not believe a separate organic phase is present in the LAW feed."

BNFL has requested a revision to the contract to gain DOE assurance that the LAW feed will not contain a separate organic phase. While this action may be prudent from a business perspective, it provides little confidence that this potential hazard has been analyzed and that the appropriate controls are in-place to detect, prevent or mitigate the hazard. While the likelihood of accumulation may be small, and the potential consequence from abnormal conditions equally small, it is prudent to address the issue technically, including the potential impact of immiscible organic on operability of IX.

The contractor should, as a minimum, (1) evaluate the immiscible organic hazard and (2) consider administrative controls on sampling of the surface liquid in AP-106 at an appropriate frequency, and a minimum liquid level above the pump suction that is to be maintained in the tank.

Question # 69 **Status** Acceptable

Cited Submittal Text

Pg. 4-126, "The potential events for the cold chemical storage area were not covered by the hazards analysis. A separate safety review examined the hazardous situations in that area."

Pg.. 4-129, Accidents involving nitric acid and anhydrous ammonia storage tanks are included in Table 4-28, Events with Potentially Serious or Major Consequences to the public or co-located worker.

Pg. 4-169 through pg. 4-179 analyzes the consequence of accidents to the public and the co-located worker involving nitric acid and anhydrous ammonia storage tanks.

Pg. 4-183, Tables 4-46 and 4-47, Design Class II SSCs, identifies the nitric acid and anhydrous ammonia storage tanks as passive design features without TSR (LCR) requirements.

Pg. 9-2, Section 9.1.1.2, Emergency Operations Center, "The EOC is able to support staff operations for extended periods of time during emergency response."

Cited Reference BNFL-5193-ISA-01, Rev. 0, Initial Safety Analysis Report (ISAR)

Evaluation Criteria DOE/RL-96-0003, Regulatory Process, Section 3.3.2, Item 3, "The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled."

Discussion The consequence analysis for the anhydrous ammonia accident indicates that the exposure standard (air concentrations above EPRG-2) extends a distance of 8km (the toxic end-point). The consequence analysis for the nitric acid accident indicates that the exposure standard (air concentrations above TEEL-2) extends a distance of 320 m. Extrapolating these concentrations and distances, it is obvious that the concentrations at or near the building approach or exceed IDLH levels.

Anhydrous ammonia tanks are typically equipped with pressure safety valves (psv). PSVs are not passive design features. They require periodic inspection, maintenance, and operability testing, and are often candidates for TSR (LCR) coverage.

Description 1. Determine what impact these accident scenarios could have on the habitability of the control room and the EOC, assuming air with high concentrations of these chemicals are drawn into the building air supply.
2. Could a chemical accident scenario initiate an uncontrolled release of radioactivity due to forced evacuation or some other unplanned operator action?
3. What preventive or mitigative features are required, or are being considered?
4. Is the safe shutdown of the process at risk?

Contractor Response 1. The ammonia and nitric acid chemical release events are to be prevented as there is no reasonable means for mitigating the events. However, in accordance with BNFL design philosophy, if it is determined that a system is needed to protect the individuals in the control room or the ECO, this mitigating system will be designated as Safety Design Class.

2 and 4. As the events are to be prevented there would be no need to evacuate the control room for the postulated events.

3. Prevention of breach of the tanks will require barrier protection. To stop leaks in the chemical distribution systems for the systems, leak detection and isolation will be required.

Disposition The BNFL response is acceptable.

Question # 70 **Status** Acceptable

Cited Submittal Text See Discussion

Cited Reference BNFL-5193-ISA-01, Rev. 0, Initial Safety Analysis Report (ISAR)
BNFL-5193-HAR-01, Rev. 0, Hazards Analysis Report (HAR)

Evaluation Criteria DOE/RL-96-0006, General Radiological and Nuclear Safety Principles, Defense-in-depth (4.1.1)

Discussion Risk Minimization verses Risk Acceptance

The ISAR, Section 4.6.4, Identification of Accident Prevention and Mitigation Features (p. 4-123) describes the iterative and interactive nature between the hazards and accident analyses and the design process to "ensure that safety is built into the design process" through the identification of "preventive and mitigative engineered and administrative controls to be added to the design."

However, the design process appears to end at demonstration of compliance with the exposure standards. Multiple ISAR statements indicate that exposure standards cited in ISAR Table 4-27 and Sections 4.6.4.1/2 are being used as a measure of regulatory compliance and risk acceptance without appropriate application of defense in depth or risk minimization strategies. (Refer also to SRD Figure 3-2).

Examples

ISAR Section 4.6.4.1, p. 4-119, "...exposures are compared to the radiological (and chemical) exposure standards of Table 4-27 (and EPRG-2) to determine the need for accident prevention or mitigation features for public safety." "...if not satisfied, engineered or administrative controls are added until the standards are satisfied."

ISAR Section 4.6.4.2, p. 4-121, "...projected exposure is compared to the standards...."

ISAR Section 4.6.4.2, p. 4-123, "Accident prevention and mitigation controls are added to the design as necessary to satisfy the worker accident goals."

These examples do not appear consistent with BNFL's philosophy of integrating the development of safety criteria and design requirements, the hazards analysis and accident analysis process, and the facility design to minimize risk associated with these hazards and hazardous situations."(ISMP Section 1.2, p. 1-2)

Defense in Depth

ISAR Section 3.6, Human Factors, p. 3-46, states that the BNFL "design philosophy emphasizes the use of engineered features over administrative controls as human actions. Human performance is an element of the defense-in-depth philosophy." The ISAR, however, does not provide insight into BNFL's design philosophy regarding preference or hierarchy of preventive verse mitigative design features, or active verses passive design features. Discussion of bounding accident scenarios in ISAR Section 4.2.7, Accidents focuses on identification and classification of mitigative features and passive design features.

The hazards and accident analyses documented in the HAR and ISAR discuss numerous events where personnel actions or inactions may be important in prevention of accidents or mitigation of accident consequences. However, deficient operating descriptions, deficient descriptions of accident scenarios, and the absence of event trees, prohibit identification of personnel actions most important to accident prevention. These same deficiencies also prohibit the identification of those active engineered safety features most important to accident prevention.

Description

1. Clarify BNFL's safe design philosophy regarding the difference between risk minimization and risk acceptance based on exposure standards.
2. What approach or criterion is used to direct the design towards risk minimization for higher frequency-lower consequence events?
3. In developing multi-layered defense in depth strategies, what approach or criterion is used to direct the design towards engineered safety features for prevention of higher frequency-lower consequence events rather than application of administrative controls?
4. Does BNFL's safe design philosophy include the designation and classification of those active engineered controls most important to accident prevention, and are these active engineered controls candidates for TSR coverage?

Contractor Response

1. BNFL's safety approach ensures that risk minimization is achieved by specifying controls appropriate to the hazard severity; the requirement to meet exposure standards is additional. Risk minimization is achieved by specifying an appropriate level of protection commensurate with the hazard severity. Hazard severity is defined in terms of risk. Risk acceptance based on exposure standards is a subset of the overall approach to safety. Having identified the required protection in order to control a particular hazard, the potential for that hazard to cause exposure standards to be exceeded is determined. If standards can be exceeded, part of the protection already specified is designated are Safety Design Class. BNFL outlined its safety approach during the meeting of 2/13.

2. The severity of identified hazards are established by qualitative and quantitative means; protection is specified which is commensurate with the hazard severity. This specification is risk-based, using frequency and consequence estimations. This ensures that events considered to have moderate risk (high frequency, low consequence events) have an appropriate level of control specified so as to minimize the risk. SSCs so identified as defined as important to safety.

For the Part A concept design only those SSCs required to ensure public and worker exposure standards would not be exceeded, were explicitly specified; SSCs specified as Safety Design

Class. This was to show that the design could demonstrate safety. A comprehensive set of SSCs important to safety which will include SDC SSCs will be identified to support the detailed design in Part B.

3. ISAR Appendix A, Section 4.1, "Defense-in-Depth" describes the elements and implements of the TWRS-P Project approach to defense-in-depth. It requires that preference be given to engineered features over administrative controls. Section 4.1 also describes how the application of defense-in-depth to the TWRS-P Facility design will be documented. The format of this documentation will make it apparent if over reliance is given to administrative controls.

In addition, BNFL NF 0124/1, "Operational and Engineered Protective Measures," requires that preference be given to Engineered Protection Systems over Operational Preventive Measures (Section 4.4, "The Contribution to be Made by Operational Preventive Measures"). NF 0124/1 is to be applied to the design of the TWRS-P Facility.

4. The BNFL Inc. design philosophy considers active engineered controls designed to prevent or mitigate accidents to be candidates for TSR coverage.

The ISMP, draft Rev 1, and the ISAR, rev 0, provide similar descriptions of the bases for TSRs and LCRs; the difference based on protection of the public or protection of the worker. This difference if being removed, therefore the bases for TSRs discussed in response to this question are different from those stated in the ISMP and the ISAR. A revised basis for the TSRs is provided below.

The development of the technical safety requirements, if required, that are based on

a) A process variable, design feature, or operating restriction that is an initial condition (i.e., the assumed facility state) for an accident analysis

b) Structures, systems, and components that must function to maintain compliance with worker or public radiological and chemical exposure standards or to prevent criticality.

This description is based on that specified in 10 CFR 50.36 for technical specifications for commercial nuclear power plants.

As discussed in ISAR Section 4.8.2, Administrative Controls, TSRs are administrative controls created to provide assurance of the continued operability of engineered features. An interlock is an example of an engineered feature installed to prevent an action if certain conditions are not satisfied. The corresponding administrative control requires that a specific test be conducted on the interlock to verify the component remains operable.

Disposition

The BNFL response is acceptable with the following comment:.

This response is accepted even though the BNFL design philosophy of using the hazards analysis and accident analysis as a design tool to identify vulnerabilities and opportunities for risk minimization of higher frequency- lower consequence (below exposure standards) operational events has not been demonstrated. Assurance is also given that future defense in depth documentation will "make it apparent if over reliance is given to administrative controls."

Question # 71

Status Acceptable

Cited Submittal Text

Material At Risk (MAR) throughout the process is based on waste envelopes, estimated separation, concentrations, and maximum capacity of process equipment as described in the TR.

Hazard ...consequence is based on the inventory... (ISAR, p. 4-116)

The selection of candidate accident scenarios for detailed analysis was made primarily from the hazardous situations.... (ISAR, p. 4-116)

It (source term) is estimated by first determining the total quantity released by the accident initiator. (ISAR, p. 4-117)

Cited Reference

BNFL-5193-ISA-01, Rev. 0, Initial Safety Analysis Report (ISAR)
BNFL-5193-TR-01, Rev. 0, Technical Report (TR)

Evaluation Criteria

DOE/RL-96-0006, Rev. 0, Section 4.1.1.3, Control states that "Normal operation, including anticipated operational occurrences, maintenance, and testing, should be controlled so that facility and system variables remain within their operating ranges and the frequency of demands placed on structures, systems, and components, important to safety is small."

Discussion

The preventive and mitigative controls most important to safety are identified and classified based on unmitigated consequences from selected bounding accident scenarios; which are based, in part, on the MAR at each location in the process. However, the TR and ISAR describe multiple process modules (unit operations) that are capable of separating and concentrating the radionuclides (MAR). Hence, it is feasible for the MAR to exceed the module inventories assumed in the analyses or allowed for in the design; possibly resulting in a need for more stringent design features such a cooling, agitation, venting, higher design classification, etc. (see ISAR Table 4-17).

Description

Describe the control strategy, including safe shutdown, that will be in effect to ensure that accumulation of MAR within any process module will not exceed the MAR assumed in the hazards and accident analysis, or challenge the equipment design specifications. Include normal and abnormal conditions such as a downstream work stoppage.

Contractor Response

In the TWRS-P Facility, most radioactive operations and maintenance occur remotely. Chemical processing takes place in stainless steel lined concrete cells built with walls that can be up to 1.5 meters thick to provide worker shielding. This design exceeds the ALARA design objective from 10 CFR 835. A cascading ventilation exceeds the ALARA design objective from 10 CFR 835. A cascading ventilation system ensures that the airflow goes from areas of lower contamination to areas of higher contamination (as described in ISAR Section 4.3.6). As equipment or material moves into or out of the process area, it goes through airlocks that in conjunction with radiation detection surveys to further control the spread of contamination.

Operators control the process from a Centralized Control Room (CCR) that has eight stations for process control as well as four stations for Balance of Plant (BOP) control. The BOP consists of the services and utilities provided to the facility. In addition, operators can control mechanically-intensive operations at the cell areas. These operations additional control include melters and product handling operations.

Operators monitor the process as waste moves among the various steps. In controlling the process, operators respond to such events as high and low indicator alarms detection of radionuclides in the effluent from ion exchange columns, and process performance parameters. The conditions requiring operator intervention are identified in facility procedures.

The facility has six operational modes during the process campaign which is anticipated to last a minimum of five years; Processing, Standby, Shut-down, Melter maintenance, Startup, and Recovery. Changing between the modes occurs only for process (e.g., lack of feed or utilities and services) or maintenance (e.g., planned outages or corrective actions) requirements. At the end of the process campaign, facility is deactivated and returns to DOE.

Processing Mode. The facility pretreats the waste prior to vitrification. Separate processing occurs for the LAW and HLW feeds. The LAW pretreatment includes evaporation, entrained solids removal, and ion exchange to remove radionuclides. The HLW pretreatment consists only of de-watering of the HLW sludge. After their respective pretreatments, both are then sent to their respective vitrification lines.

The facility can receive batches containing up to 200 cu. m of waste for LAW and 600 cu. m for HLW. To prevent the build up of solids in the line, a flush follows each batch transfer into the facility feed tanks. At 5 M Na concentration in the feed, the tanks can provide about one week of feed to the LAW melters. The HLW batch, feed tanks can provide about one month feed to the HLW melters.

The amount of waste in each LAW batch is determined by the volume of solution in the recycle streams returning to the feed tanks. These recycle streams have the largest impact on volume during the de-watering of the HLW sludge. This de-watering occurring infrequently and only for a short duration.

The design allows for semi-continuous operation to process waste. To accomplish this processing, the facility equipment operates continuously, is duplicated, or is sized based on cycle time to provide enough feed to the next process step so the next cycle can continue to operate until its next input batch is ready. For duplicated equipment, the dual trains allow processing of the waste in one train while the next batch is being prepared for processing. Transferring between the process trains occurs by closing and opening of valves on each train. The design allows for time necessary to accomplish these valving operations by vessel sizing to permit ample upstream and downstream hold-up time.

The facility has three LAW melters and one HLW melters and one HLW melter in operation. Each melter receives feed from one of two melter feed tanks and discharges to one of two pouring chambers on the melter. Melter feed tanks provide waste mixed with glass formers. Each pouring chamber has two glass-product packages (containers for LAW or canister for HLW) ready to receive the waste. Waste is poured from the melters by raising the glass pool level above the pouring weir. Air lifts in the melters are used to raise the pool level.

The product handling occurs inside the shielded cells from container/canister filling through and include storage. Product handling welds packages closed, decontaminates packages, and transfers the packages to storage to await transfer to DOE. The product packages only leave the cells for shipment to the DOE.

Standby Mode. The standby mode is used when the need arises for the facility to stop waste processing waste processing waste for a duration up to twenty-four hours. This mode allows for short upsets that could occur in feed delivery or utilities and services. The equipment in the facility is placed in a configuration to allow processing restart with the minimum amount of actions by the operators (e.g., the steam would be reduced to evaporators, but the evaporators would be maintained at temperature).

Disposition

The BNFL response is acceptable with the following comment:

The response demonstrates that the process is capable of , and requires the flexibility for, separating, concentrating and recycle of MAR for process upsets, equipment failures and operating modes. This capability is normal for continuous or semi-continuous chemical process unit operations. However, the response does not describe, as requested, a control philosophy that will maintain the in-situ MAR inventories within the limits assumed in the bounding accident scenarios and equipment design specifications for each process module and facility operating mode.

The response does not acknowledge the need for operating restrictions on the process in the form of administrative controls including TSR LCOs as deemed appropriate. The response does not acknowledge a need for process instrumentation and controls to measure and limit the near-real-time MAR inventories at key locations in the process. An appropriate response to this question in SAR language, commensurate with the state of design evolution, should be very simple and straight forward.

The response to Question 80, referenced in the response to this question, relates to accident scenarios and analysis assumptions that bound MAR in source term development, and, therefore is not germane to the issue. The issue is not defensibility or conservatism of the MAR assumed, but how the MAR will be measured and controlled within the bounding assumptions. ISAR Questions and responses 59, 60, 61, and 60 are more germane to this issue than is Question 80.

Question # 72

Status Acceptable

Cited Submittal Text

In Table 4-34, in ISAR Section 4.7.2, "Accidents," for liquid loss of confinement, the bounding accidents are for failure of the LAW and HLW Receipt Tanks, for the LAW only and LAW/HLW options, respectively. In Section 4.7.1, "Accident Selection," other liquid loss of confinement accidents were analyzed, such as a failure in the LAW transfer line. While having the potential for a high dose equivalent, this scenario was considered bounded by the receipt tank failure.

Cited Reference

BNFL submittal BNFL-5193-ISAR-01, Rev. 0, "Initial Safety Analysis Report A-4," dated January 12, 1998; Sections 4.7.1 and 4.7.2, pages 4-132 and 4-133 and 4-147 through 4-152.

Evaluation Criteria

DOE/RL-96-0003, Rev.0, "DOE Regulatory Process for Radiological, Nuclear, and Process Safety for TWRS Privatization Contractors," dated February 1996, section 4.2.2, "Contractor Input," states in part that the Initial Safety Assessment shall consist of the following documentation: 5) Description of potential design-basis events; and 6) Analysis of the potential design-basis events. The associated review criterion is to determine the acceptability of the results of analysis of representative design basis events (DOE/RL-96-0003, Rev.0, p. 6 of 35, Section 3.3.2, item 5).

Discussion

The RU reviewers noted that the postulated accidents are not clearly linked to the summary of the hazard analysis in Section 4.7.1, "Accident Selection." For instance, Section 4.7.1.2.1, "Loss of Confinement (Liquid Release)," discusses six postulated events and identifies two scenarios as the bounding events to be analyzed further in Section 4.7.2, "Accidents." The two scenarios selected for further analysis appear to duplicate the design basis earthquake in Section 4.7.2.10.

The contractor should consider in the suite of accident scenarios the possibility of an outside cell loss of confinement that occurs in the process building, i.e., at a cell penetration or intracell transfer, since neither the cell and C5 ventilation system would be available.
Specifically, on page 4-133, the contractor states that there will be further investigation to determine if the leak in the transfer line is credible for the facility. While this may or may not be considered a credible scenario at this preliminary design stage, the contractor should continue to provide the analysis of calculated potential dose and the effect of mitigative features in Section 4.7.2.

Based on Table 4-29, the transfer line between 241-AP-106 and TWRS-P leak into the transfer pit have a source term (dose equivalent) of 3.3 x 109 Sv which is greater than the 8.3 x 108 Sv for the LAW Receipt Tank accident.

Description

1. The postulated accidents should be linked to the summary of the hazard analysis in Section 4.7.1, "Accident Selection."
2. The ISAR should either justify why the LAW Receipt Tank accident is the bounding case or revise the bounding accident scenario to be the leak into the transfer pit during transfer of waste between 241-AP-106 and TWRS-P.
3. Please provide justification on the selection of the bounding accident scenarios.

Contractor Response

The question of linkage, or lack thereof, is best answered by tracing the Loss of Confinement Events from the HAR through the screening process to the postulated accidents. The 6 Loss of Confinement (Liquid Release) events with HAR event identifiers are listed in Table 4-28, of Section 4.7.1, Accident Selection, the screening analysis to determine the bounding accident follows in Section 4.7.1.2.1, Loss of Confinement (Liquid Release) and the results are summarized in Table 4-29. The list of 6 Loss of Confinement events was expanded in the summary table because of the consequences of HLW Melter Leak events, numbered 5 and 6 in the Table 4-29, were particularly high. Hence it was surmised then demonstrated that catastrophic failure (more than a leak) of the HLW Receipt Tank, in particular and the LAW Receipt Tanks would pose a significant hazard to the worker and the public. The LAW Receipt Tank and the LAW Receipt Tank, listed in Table 4-29, is then listed in Table 4-34 in Section 4.7.2, Accidents, as accidents subject to further analysis. The consequence for these two bounding events are determined in Section 4.7.2.1, LAW Receipt Tank Failure and Section 4.7.2.2 HLW Receipt Tank failure. In summary, the Loss of Confinement (Liquid Release) are traceable from Section 4.7.1 through the consequence calculation through the tables in each section.

The failure of the LAW and the HLW Receipt Tanks were postulated in the earthquake scenario. Where the mechanism of individual vessel and systems failures were comparable to those induced by an earthquake failures, these were applied in the earthquake analysis.

BNFL Inc. did consider in all accident scenarios the loss of cell confinement. "All accidents are analyzed unmitigated, i.e., without credit for engineered or administrative controls" (Section 4.6.4.1, Protection of Public Safety" 2nd para, 1st sentence). "For the worker, accidents are first analyzed unmitigated, i.e., without credit for engineered or administrative control" (Section 4.6.4.2, Protection of Worker Safety, 5th para, 1st sentence). In other words, all accidents are modeled as if they occurred in an open field at the plant site.

The reviewer correctly points out in part 2 of his comment that the process for selection of bounding events finds that the overflow of the transfer pit is potentially a high consequence event that is not carried forward and addressed in Section 4.7.2, Accidents. This is not a new TWRS-P accident identified in the course of this analysis but an accident analyzed in support of the Tank Farm Basis of Operation. This is not an event unique to TWRS-P or distinctive modification required by TWRS-P operation of 241-AP-106. The mitigating measures associated by transfer pit operation have been selected as a result. These same features will be consistent across the 241-AP-106 without reference to ownership. The measures for mitigation of a transfer pit overflow are extensive, including, a drain (passive measure), multiple leak detectors, area radiation surveillance, and manned surveillance of the transfer and transfer system. The LAW Receipt Tank failure is a unique TWRS-P incident requiring appropriate mitigating measures.

The justification for selection methodology is demonstrated by the fact that it did indicate that the transfer pit overflow was potentially a bounding event. The error was in not providing an explanation of that current tank farm design and surveillance practices already in place provide event mitigation.

Disposition

The BNFL response is acceptable.

Question # 73 **Status** Acceptable

Cited Submittal Text

On Table 4-29, Dose Equivalent are given in sieverts, dose equivalents on Tables 4-39 and 4-40 are given in rems. The conversion from sieverts to rems seem to be wrong, in that for example, for the transfer line between 241-AP-106 and TWRS-P the dose equivalent in Table 4-29 is given as 5.8 x 108 Sv, but on Tables 4-39 and 4-40 is given as 5.0 x 106 rems, when in fact it should have been 5.8 x 1010 rems.

Cited Reference

BNFL submittal BNFL-5193-ISAR-01, Rev. 0, "Initial Safety Analysis Report A-4," dated January 12, 1998; Table 4-29, page 4-133, Tables 4-39 and 4-40 pages 4-174 and 4-175.

Evaluation Criteria

DOE/RL-96-0003, Rev.0, "DOE Regulatory Process for Radiological, Nuclear, and Process Safety for TWRS Privatization Contractors," dated February 1996, section 4.2.2, "Contractor Input," states in part that the Initial Safety Assessment shall consist of the following documentation: 5) Description of potential design-basis events; and 6) Analysis of the potential design-basis events. The associated review criterion is to determine the acceptability of the results of analysis of representative design basis events (DOE/RL-96-0003, Rev.0, p. 6 of 35, Section 3.3.2, item 5).

Discussion

Tables 4-39 and 4-40 appear to have values that are incorrect; the dose equivalent values (rem) appear to be a factor of 104 too low when compared to the values (in units of SV) presented in Tables 4-29 and 4-30. Table 4-39 and 4-40 present "new" dose equivalent values (under the same heading) that appear to have been multiplied by the ARF and RF values. No explanation is provided with the consequence analyses presented in Section 4.7.2.10.3.

Since one sievert is equal to 100 rems, 5.8 x 108 Sv be equal to 5.8 x 1010 rem and not the 5.0 x 106 rem as indicated on Tables 4-39 and 4-40. Please note that 5.0 x 106 rem should be 5.8 x 1010 rem. It may be that in going from Table 4-29 to Tables 4-39 and 4-40, the dose equivalent in Table 4-29 was converted to its inhalation dose equivalent, but this was never explained in the text. If this was the case, it should be stated in the text to avoid any future confusion. Incidentally, the use of rem for such high doses is not technically correct.

On page 4-147 of ISAR Table 4-39, the calculation of the release quantity for the spill of the contents of seven cesium product canisters from a design basis earthquake appears to be incorrect. Each canister is state in Section 4.7.3.2.1 to hold up 6000 TBq (6.0 x 1015 Bq) of cesium-137. Seven canisters would hold 4.2 x 1016 Bq, not 4.2 x 1015 Bq as found in Table 4-39. It is noted, however, that the dose equivalent value in the same table appears to be correct.

These examples illustrate why it is difficult to evaluate some of the accident analyses. No information is provided on the assumptions used in the selection of some parameter values and conversions are made without explanation (i.e. tables as cited above). The analysis can be reconstructed, but with considerable difficulty. An objective of this review is to determine whether the rationale and methods are adequate. An assessment of the adequacy of the presentation of the analyses is included in this review.

Description

1. Please verify that the dose conversion has been performed correctly and clarification of the parameter values used in the accident analyses.
2. Please indicate what measures are being taken, if any, to improve the presentation of the accident analyses.

Contractor Response

1. The values in the last column of ISAR Tables 4-39 and 4-40 are the contributions to the airborne respirable release for each of the major failures postulated to occur from the earthquake. To obtain those values, the same assumptions were used as for the same failures postulated to occur from other causes and described in ISAR Sections 4.7.2.1 through 4.7.2.7. Therefore, they are not inconsistent with the values in tables 4-29 and 4-30. A statement to this effect is included in summary Table 4-34.

2. A clear statement of the basis for the release values should also have been included in Section 4.7.2.10.2. For the failures not described elsewhere in Section 4.7.2, such as the transfer line break, the assumptions used in obtaining the respirable airborne release will be added. The heading of the last column of Tables 4-39 and 4-40 will indicate that the values represent the airborne respirable release.

The following is the information to complete the source term development in Section 4.7.2.10.2.

Airborne Release Estimates for the Design Basis Earthquake Accident Analyses

The source terms, ARFs and RFs used for the earthquake analyses are the same as those used for the individual systems assumed to fail as a result of the earthquake. For instance, the contribution to airborne release from failure of the LAW receipt tanks is assumed to be the airborne release from failure of one tank, as given in Section 4.7.2.1, multiplied by the number of tanks (2).

A few systems were included in the earthquake analysis for which detailed analyses were not provided elsewhere in Section 4.7.2. The assumptions used to estimate their contribution to the earthquake source terms follows:

For both options:

Transfer line break: The assumed respirable airborne release from the pipeline break was 12 L Envelope B waste. The reference given, Hall 1996, estimated 12 L airborne respirable material from the pipeline spill analyzed for the TWRS SAR. The radionuclide composition of the Envelope B waste is the same as that used for analysis of the LAW receipt tank failure in Section 4.7.2.1.

For the HLW/LAW option:

Failure of the Cesium/Technetium Product Tank: Tank radionuclide inventory is 2 x E+17 Bq 137Cs and 9 x E+14 Bq 99Tc as given in Table 4-1 of the BNFL TWRS-P Hazard Analysis Report. Airborne Release Fractions and Respirable Fractions are the same as those used for the failure of the LAW receipt tanks in Section 4.7.2.1.

Disposition The BNFL response is acceptable.

Question # 74 **Status** Acceptable

Cited Submittal Text Section 4.7.2.1.2, "Source Term Analysis" which states that the waste feed is delivered with a sodium concentration between 3 M and 14 M. For the purpose of this analysis, the basis is 7M sodium.

Cited Reference BNFL submittal BNFL-5193-ISAR-01, Rev. 0, "Initial Safety Analysis Report A-4," dated January 12, 1998.

Evaluation Criteria DOE/RL-96-0003, Rev.0, "DOE Regulatory Process for Radiological, Nuclear, and Process Safety for TWRS Privatization Contractors," dated February 1996, section 4.2.2, "Contractor Input," states in part that the Initial Safety Assessment shall consist of the following documentation: 5) Description of potential design-basis events; and 6) Analysis of the potential design-basis events. The associated review criterion is to determine the acceptability of the results of analysis of representative design basis events (DOE/RL-96-0003, Rev.0, p. 6 of 35, Section 3.3.2, item 5).

Discussion The LAW source term used in the accident analyses is based on the content specified in Contract Specification 7, Envelope B. The source term assumes a 7 M sodium feed solution rather than a bounding 14 M sodium feed solution. Although the impact of this assumption which results in a consequence estimate a factor of two lower than the bounding condition is understood, assessing the adequacy of BNFL analysis includes assessing the justification of their assumptions. BNFL approach to accident mitigation is summarizes in their RESW. It states that "in addition to meeting the listed dose standards for accidents, BNFL's approach to accident mitigation is to evaluate accident consequences to ensure that the calculated exposures are far enough below standards to account for uncertainties in the analysis, and to provide for sufficient margin and operational flexibility."

Description 1. Please provide a justification for the source term being based on a 7 M sodium feed solution rather than the bounding 14 M sodium feed solution.
2. Please explain how the assumption is consistent with the BNFL approach to accident mitigation and ensuring a margin of safety in the facility design as described in the RESW.

Contractor Response 1. The contract allows for the DOE to transfer waste into Tank 241-AP-106 with sodium concentration between 3 M to 14 M. BNFL Inc. does not transfer the waste to its facility within these ranges. Tank sizes have been based 3 M sodium concentration to allow the facility to process the most dilute waste transfer to 241-AP-106. Down stream processing in cesium ion exchange require the feed to be 5 to 7 M sodium. The batch transfer is based on the amount of sodium in feed batch necessary to have a terminal concentration of 7 M sodium or less. A higher concentration would require dilution to support ultrafiltration, Sr/TRU precipitation, and cesium ion exchange.

2. With respect to LAW receipt MAR, the margin comes from using the maximum contract values for the ratio of radionuclides to sodium and the maximum allowable concentration. Using these ratios provides large margins of error. The contract specification for cesium in Envelope Feed B is 6E+10 Bq per mole of sodium. The highest cesium concentration per mole of sodium identified in "Tank Waste Remediation System Operation and Utilization Plan," HNF-SD-WM-SP-012, Rev 0A, based on processing the waste in September of 2005 is 9E+09 for Tank 241-AZ-101. The current concentration of this waste is at less than 5 M (about 4.7 M) sodium. This waste can not be processed in the 242-A Evaporator and as such DOE can't concentrate the waste prior to transfer to BNFL Inc. The combination of the ratio and concentration assumptions leads to about a factor of 10 in margin for the MAR.

Disposition

The BNFL response is acceptable with the following comment:

The February 19, 1998, BNFL response with regard to providing justification for the source term being based on a 7M sodium feed solution rather than the bounding 14 M sodium feed solution and providing an explanation of how the BNFL approach to accident mitigation provides a margin of safety were evaluated and found to be both responsive and acceptable. However, it is noted that the intent of the ISAR is to conduct an initial, worst-case accident analysis, that includes identified margins of safety, in order to obtain an initial determination of the design conditions that require safety class systems and components. In this regard, assuming the worst case inventory associated with 14M sodium feed for Envelope B wastes would seem to be more consistent with the stated level of design completed at this time. Assuming the maximum source term at this stage will also assure that any process changes that occur between now and the final design will not cause a significant increase in the identified safety features that are required.

Question # 75 **Status** Acceptable

Cited Submittal Text

Section 4.7.1.1, "Sorting of High Consequence Events, page 4-127, Table 4-28.

Cited Reference

BNFL submittal BNFL-5193-ISAR-01, Rev. 0, "Initial Safety Analysis Report A-4," dated January 12, 1998.

Evaluation Criteria

DOE/RL-96-0003, Rev.0, "DOE Regulatory Process for Radiological, Nuclear, and Process Safety for TWRS Privatization Contractors," dated February 1996, section 4.2.2, "Contractor Input," states in part that the Initial Safety Assessment shall consist of the following documentation: 5) Description of potential design-basis events; and 6) Analysis of the potential design-basis events. The associated review criterion is to determine the acceptability of the results of analysis of representative design basis events (DOE/RL-96-0003, Rev.0, p. 6 of 35, Section 3.3.2, item 5).

Discussion

On page 4-127 of ISAR Table 4-28, there is a listing of events that have potentially serious consequences to the public or the co-located worker. The selection of bounding accident scenarios does not cover several postulated events that appear to have significant consequences. It appears that events such as spray leaks (e.g., from transfer lines), resin/CST column explosions, and hydrogen deflagrations are not included. In addition, heat generated by exothermic reactions involving organic compounds is not considered, but could be an important initiating event of fire or explosion/overpressure hazards.

The selected accident scenarios did not appear to consider a number of energy sources, (e.g., chemical energy, pressure, electrical energy, and heat) that were listed in Section 4-3 and Table 4-5 of the HAR were considered in the hazard analysis, but the following issues were apparently ignored.

Some scenarios are not adequately explained to determine whether the scenario is bounding. An example is the analysis the cesium ion exchange column fire. No information is presented on the cooling system for the column although the scenario is initiated by a loss of cooling water. Another example is the estimate for the duration of release for the molten glass spill accident.

These events appear to have the potential to increase accident consequences and DC requirements and therefore need to be addressed in the accident analyses.

Description

Please address and provide additional rationale for the selection of bounding accidents considering the accident scenarios described above.

Contractor Response

A spray leak from a transfer line was included in the analysis, please see the response to question 72 and question 79. Note that the effects of such a catastrophic leak are independent of the release mechanism, the leak takes place below grade (into the soil), the consequences arise from the surface pool which is subsequently formed.

A resin explosion was analyzed and the inhalation dose equivalent to worker and public estimated (see ISAR pg 4-162 to pg 4-164). An explosive overpressure release from the CST canister was analyzed in Section 4.7.2.6. The CST vessel serves as both an ion exchange column, drying vessel and the product container. The potential for the column to explosively release its contents is higher when the column is sealed as product container. Then any liquid present after drying is subject to radiolysis. Hydrogen deflagrations identified in the binning process and subject to further analysis, and tabulated in Table 4-31, "Summary of Flammable Gas Fire/Explosion Events" (ISAR pg 4-141), are an explosion in the HLW Vitrification Offgas Treatment System, an explosion in the ultrafilter used for dewatering Envelope D waste, and deflagration in the vapor space of the HLW Melter Feed Receipt Tank. The DOE Handbook indicates that the release fractions for explosion in the vapor space over solution or slurries as the case may be are low, in the range of 1E-04 (see Section 3.2.2.3.1 and 3.2.2.3.2) therefore the bounding accident selected is the Cs ion exchange which has a much higher ARF. As stated in the text (page 4-142) both the explosion in the HLW Receipt Tank vapor space and the ultrafilter need further quantification.

The chemical, pressure, and electrical source driving these events are reflected in the derivation of the ARF in the DOE Handbook. For example, the ion exchange column ARF is a function of the superheat generated by the chemical exotherm.

Loss of cooling in an ion exchange column was considered to be a contributory cause to a fire/explosion hazard from resin degradation and subsequent violent reaction. This hazard was considered to be bounding in terms of potential consequences. No analysis was carried out to identify the sensitivity of the need for column cooling to the potential for resin overheating and subsequent degradation Such analysis depends on the design detail of the cooling water system and a knowledge of the contributory causes (initiating events) which could lead to the potential for resin degradation This is a part B activity.

The modeling of the molten glass spill (bounding) accident, section 4.7.2.7, ISAR page 4-167 used the same methodology as that applied to DWPF at Savannah River.

Disposition

The BNFL response is acceptable with the following comment:

The BNFL response to Question 75 is both responsive and acceptable. The February 19, 1998, BNFL response with regard to the selection of bounding accidents, especially with regard energetic events such as spray leaks, column explosions, and hydrogen deflagrations was evaluated. The response referenced Table 4-31 on page 4-141, indicating that a wide range of energetic accidents had been considered. However, the linkage between the accidents discussed in Section 4.7.1 and those analyzed in Section 4.7.2 is not well explained. Part of the difficulty is that particular accidents are described as "events" in Section 4.7.1, and they are assigned event numbers for ease of discussion. These numbers are not carried forward into Section 4.7.2, making it sometimes difficult to keep track of which events are intended to bound which situations. Further, the use of dose equivalent (i.e., Sv), based on the unit liter dose factor times the volume (liters) associated with each event (as shown in Tables 4-31 and 4-32) is unfortunate in that it may imply real doses to lay readers, when the values are simply used to rank the potential importance of the accidents and to determine which ones require additional analysis.

Question # 76 **Status** Acceptable

Cited Submittal Text

Section 4.6.3 and Table 4-26, page 4-119.

Cited Reference

BNFL submittal BNFL-5193-ISAR-01, Rev. 0, "Initial Safety Analysis Report A-4," dated January 12, 1998; Chapter 4, "Integrated Safety Analysis."

Evaluation Criteria

DOE/RL-96-0003, Rev.0, "DOE Regulatory Process for Radiological, Nuclear, and Process Safety for TWRS Privatization Contractors," dated February 1996, section 4.2.2, "Contractor Input," states in part that the Initial Safety Assessment shall consist of the following documentation: 5) Description of potential design-basis events; and 6) Analysis of the potential design-basis events. The associated review criterion is to determine the acceptability of the results of analysis of representative design basis events (DOE/RL-96-0003, Rev.0, p. 6 of 35, Section 3.3.2, item 5).

Discussion

The lung clearance class assumed for radionuclides Sr-90 and Co-60 are based on the elements being in soluble form. If the elements were in insoluble form, the selected lung retention classes in

Table 4-26 would not be appropriate. An objective of the review is to determine the appropriateness of the assumptions used in the accident analyses. It is noted that the consequences of the radionuclides Sr-90 and Co-60 is approximately 1000 times lower than for Cs-137 in all accidents analyzed and therefore a change in lung retention classes would have essentially no impact on the results of the calculations.

Description

Are the lung clearance classes assumed for all radionuclides in the source term consistent with the chemical forms of the source term elements specified in contract?

Contractor Response

The chemical form of the radionuclides was considered in deciding the lung clearance classes to assume for determining the inhalation dose conversion factors. The lung clearance classes assumed for all radionuclides are based on the guidance provided in Table 3, "Gastrointestinal Absorption Fractions and Lung Clearance Classes for Chemical Compounds" of the reference document, EPA-520/1-88-020, Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion and Ingestion.

Disposition

The BNFL response is acceptable with the following comment:

The February 19, 1998, BNFL response with regard to the identification of lung clearance classes assumed for radionuclides in the source term was evaluated and found to be both responsive and acceptable. However, it is noted that those selected do not lead to a worst case evaluation for cobalt-60 and strontium-90. Modifying these lung clearance classes will slightly modify the results generated for Envelope B and Envelope D wastes.

Question # 77 **Status** Acceptable

Cited Submittal Text

Sections 4.1.3.4, "Short-Term Diffusion Estimates," page 4-14.

Cited Reference

BNFL submittal BNFL-5193-ISAR-01, Rev. 0, "Initial Safety Analysis Report A-4," dated January 12, 1998.

Evaluation Criteria

DOE/RL-96-0003, Rev.0, "DOE Regulatory Process for Radiological, Nuclear, and Process Safety for TWRS Privatization Contractors," dated February 1996, section 4.2.2, "Contractor Input," states in part that the Initial Safety Assessment shall consist of the following documentation: 5) Description of potential design-basis events; and 6) Analysis of the potential design-basis events. The associated review criterion is to determine the acceptability of the results of analysis of representative design basis events (DOE/RL-96-0003, Rev.0, p. 6 of 35, Section 3.3.2, item 5).

Discussion

In the discussion of "Short-Term Diffusion Estimates," the assumptions used to calculate c/Q include a stack flow rate, air temperature, etc. are enumerated. The ISAR text implies that identical airflow, gas temperature, and possibly stack height were used to calculate c/Q for all conditions. Because dose to the public or co-located worker is directly dependent on the c/Q values, BNFL should clarify 1) the basis of the assumptions inherent in the facility specific parameters used to calculate c/Q and 2) clearly state which assumptions and parameters apply to each case.

The discussion should address the conservatism in the parameters used in the dose calculations. For example, it appears that the dispersion coefficients used are based on a stack height significantly lower than the proposed specifications for the BNFL stack. For parameters such as this, provide 1) a comparison of the assumptions used in the determining a value for the parameter with the applicable current facility design parameters, and 2) a qualitative discussion of the conservatism of the parameter used.

Description

1. Please provide a discussion addressing the conservatism in the parameters used in the dose calculations.
2. Please clarify the basis of the assumptions inherent in the facility specific parameters used to calculate c/Q
3. Please clearly state which assumptions and parameters apply to each case.
4. Please provide a comparison of the assumptions used in the determining a value for the parameter with the applicable current facility design parameters
5. Please provide a qualitative discussion of the conservatism of the parameter used.

Contractor Response

The x/Q values given in Table 4-6 of the ISAR are those calculated for releases from a 75 m tall stack. The ones given in Table 4-7 are the ones used in the accident analysis, and were calculated using the facility assumptions listed in Section 4.1.3.4. For consistency, the values in Table 4-6 will be changed to reflect the higher stack.

1, 2, and 5) Except for the stack flow and temperature, the facility assumptions listed in Section 4.1.3.4 are the present design parameters for the facility. The stack height, building dimensions and stack diameter are physical parameters that are unlikely to change (I.e., degrade) during facility operation. The two parameters that can be varied to provide operations margin are the stack flow rate and the stack air temperature.

The stack flow rate assumed, 5.56 cu. m/s, is the preliminary design flow rate. The stack flow rate is used for calculating the buoyant plume rise. Assuming a value lower than the design flow would provide operating margin. These analyses will be refined in Part B in support of the basis for the Technical Safety Requirements.

The assumed plume temperature was 20 C, the same as ambient. The temperature of the flow also contributes to the buoyant plume rise. The assumption of ambient temperature is very conservative because the temperature of the ventilation flow coming from the process cells is expected to be higher than ambient.

3) The x/Q values given in table 4-7 are used for all the accident analyses. That is, the assumed facility parameters that affect the x/Q values are the same in all the accident analyses presented in section 4.7.2.

4) The stack height, stack diameter, building dimensions, and stack flow rate given in Section 4.1.3.4 are the current facility design values. As discussed above, the design temperature of the ventilation airflow is expected to be higher than the 20 C assumed for the calculations.

Disposition

The BNFL response is acceptable with the following comment:

The February 19, 1998, BNFL response with regard to parameter assignments, assumptions, and conservatism, associated with the estimation of X/Q values was evaluated and found to be both responsive and acceptable. While the response provided qualitative discussions of the importance of the physical parameters used in the analysis and their likely affect on the estimated X/Q, it also noted that refinements will be made in Part B to support the basis for the Technical Safety Requirements.

Question # 78

Status Acceptable

Cited Submittal Text

Details used in determining the inventories associated with the source term analyses for the accidents described in Section 4.7.2.4 through 4.7.2.7 and 4.7.2.10.

Cited Reference

BNFL submittal BNFL-5193-ISAR-01, Rev. 0, "Initial Safety Analysis Report A-4," dated January 12, 1998; Sections 4.7.2.5 through 4.7.2.7 and 4.7.2.10, pages 4-162 through 4-169 and 4-173 through 4-177.

Evaluation Criteria

DOE/RL-96-0003, Rev.0, "DOE Regulatory Process for Radiological, Nuclear, and Process Safety for TWRS Privatization Contractors," dated February 1996, section 4.2.2, "Contractor Input," states in part that the Initial Safety Assessment shall consist of the following documentation: 5) Description of potential design-basis events; and 6) Analysis of the potential design-basis events. The associated review criterion is to determine the acceptability of the results of analysis of representative design basis events (DOE/RL-96-0003, Rev.0, p. 6 of 35, Section 3.3.2, item 5).

Discussion

The accident descriptions in Section 4.7.2.4 through 4.7.2.7 and 4.7.2.10 provide insufficient details for the inventories of radionuclides involved to evaluate the adequacy of the analysis of the design basis events. Specifically: Section 4.7.2.5.2 discusses the amount of Cs-137 associated with an ion exchange column, Section 4.7.2.6.2 describes inventories of Cs-137 associated with a CST canister, Section 4.7.2.7.2 describes the inventory associated with a molten glass spill, and Section 4.7.2.10.2 assigns inventories to the four systems that are assumed to fail during the earthquake. No references to design data or other technical justifications are provided for these assumptions. Section 4.7.2.4 discusses the amount of Cs-137 and Tc-99 in the technetium/cesium product storage tank. However, the source reference for this amount is cited as reference BNFL 1997a. Reference BNFL 1997a is cited as Tank Waste Remediation System Privatization Project Quality Assurance Program in Section 13.0 "References" of the ISAR.

Description

1. Please provide references to design data or other technical justifications for the derivation of the radionuclide inventories associated with the accidents described in Sections 4.7.2.5 through 4.7.2.7 and 4.7.2.10.
2. Please verify that the reference is correct and the design data as stated in the ISAR are correct for Section 4.7.2.4.

Contractor Response

1) Sections 4.7.2.3 and 4.7.2.6 - The reference for the source term value, 6.03 x E+15 Bq 137Cs per cesium product canister is the BNFL TWRS-P Hazard Analysis Report, Section 5.2.6 (Reference BNFL 1997d in Section 13.0, "References."

Section 4.7.2.4 - The correct reference for the 137Cs and 99Tc inventory of the technetium/cesium product tank is BNFL 1997d, the BNFL TWRS-P Hazard Analysis Report. The reference callout in the text is in error.

Section 4.7.2.5 - The text states that the bounding case for ion-exchange loading is 20 column volumes of envelope B waste. One column volume is 1.048 cu. m. The source for this data is Colebrook, K. C., 1997, LAW Envelope B Mass and Activity Balance (Minimum Order Quantities), K0104_REP_069_PRC, BNFL Engineering Ltd., Manchester, U. K.

Twenty column volumes are 21 cu. m . Using the same assumptions as outlined in Section 4.7.2.1 assuming 7M Na Envelope B waste, the total 137Cs loading of the column was obtained.

Section 4.7.2.7 - The estimate of volatile radionuclides released in the glass spill scenario was independent of the total inventory of those radionuclides in the glass pool. The analytical method referenced in the text, Randall and Yau 1987, calculates the volitilization rate from the pool surface as a function of the pool cooling rate. A copy of this reference was provided to the RU on January 28.

The important parameters in the calculation are the initial pool temperature, taken as the melter operating temperature, the thermal properties of the glass, the volatilization rate as a function of temperature and the pool dimensions and depth. The design parameters used for calculating the pool dimensions are the volume of glass in a full melter and the dimensions of the melter cell.

The melter design operating temperature and the glass volume of the melter are given in Section 5.2.13 of the BNFL TWRS-P Hazard Analysis Report (BNFL 1997d). The glass thermal properties and volatilization rate are as used in the Randall and Yau 1987 reference. The melter cell dimensions are preliminary design information provided for the analysis.
Section 4.7.2.10 - SEE RESPONSE TO QUESTION 73.

2) As stated above, the reference callout in Section 4.7.2.4 is in error. The correct reference is BNFL 1997d, which is the BNFL TWRS-P Hazard Analysis Report.

Disposition

The BNFL response is acceptable with the following comment:

The February 19, 1998, BNFL responses regarding the derivation of radionuclide inventories involving cesium-137 and seeking verification to a cited reference were evaluated and found to be both responsive and acceptable. The response referenced the BNFL response Question 73. The response noted that: 1) the input in Table 4-29 provided the hazards ranking information in Sv, which simply indicates the quantity of material involved times the unit liter dose factor, while the information in Table 4-34 has been modified by the release fraction, X/Q, and inhalation rate, 2) the response outlined some of the measures to be taken to improve the presentation of the accident analysis, including providing a more complete source term development for the earthquake event.

Question # 79

Status Acceptable

Cited Submittal Text

Details used in determining the airborne release fractions (ARFs) and respirable fractions (RFs) for the accidents described in Sections 4.7.2.3, 4.7.2.7 and 4.7.2.10.

Cited Reference

BNFL submittal BNFL-5193-ISAR-01, Rev. 0, "Initial Safety Analysis Report A-4," dated January 12, 1998; Section 4.7.2.10, pages 4-164 through 4-169 and 4-173 through 4-177.

Evaluation Criteria

DOE/RL-96-0003, Rev.0, "DOE Regulatory Process for Radiological, Nuclear, and Process Safety for TWRS Privatization Contractors," dated February 1996, section 4.2.2, "Contractor Input," states in part that the Initial Safety Assessment shall consist of the following documentation: 5) Description of potential design-basis events; and 6) Analysis of the potential design-basis events. The associated review criterion is to determine the acceptability of the results of analysis of representative design basis events (DOE/RL-96-0003, Rev.0, p. 6 of 35, Section 3.3.2, item 5).

Discussion

The accident descriptions in Sections 4.7.2.1 through 4.7.2.10 provide insufficient details to determine the acceptability of the results of the analyses. More information is needed on the estimation of airborne releases using airborne release fractions (ARFs) and respirable fractions (RFs).

For example, the accident description in Section 4.7.2.3 uses an ARF for a free fall of powders for distances less than 3 m. Since the canister is over 11 meters tall, a spill due to tipping of the canister will be greater than 3 m.

For the Cesium Ion-Exchange Column Exothermic Reaction accident scenario, the atmospheric release fraction (ARF) should be explained. It would appear a value more appropriate to an exotherm (i.e., temperature increasing) reaction should be used for this scenario instead of a value corresponding to a flashing spray (i.e., constant or decreasing temperature). The assumption could significantly impact the source term. The ARF for the resin release (0.01) seems unrealistically low - the resin is not only under thermal stress but is burning and volatilizing in the exotherm - the analysis should consider and/or evaluate the use of a higher value which may be more appropriate.

Additional justification, description of assumptions, or reference pages, as appropriate, on the selection of the ARF values selected for the accident analyses including those scenarios for the design basis earthquake events, CST pressurization and rupture, spray leaks from the transfer lines, releases due to hydrogen deflagrations, failure of a HLW receipt tank, failure of a LAW receipt tank, and a release due to boiling of the cesium/technetium product tank.

Description

Please provide the airborne release fractions (ARFs) and respirable fractions (RFs), as well as the justification for selected values, for accidents identified above.

Contractor Response

No error was made in assigning the ARF for the free fall of powders. The ARF was for powder impact from a height of less than 3 meter because the canister is 113.6 cm high. The design of the facility has not found that movement and transfer of a 1 m tall canister above the 3 m is necessary. The results of this analysis would rule against such a design. References for the canister height is the HAR, page 5-78 and in the ISAR page 4-157. However, there is an error in ISAR in the conversion from centimeters to inches; 113.6 cm is 44.7 in. not 288.5 in.

The TWRS-P cesium ion exchange column incident is based on the exothermic reaction as determined in the re-construction of ion exchange column explosion accidents. This is basis of the analysis methodology in DOE-HDBK-3010-94 which is the basis of the TWRS-P analysis. The DOE Handbook analysis after a introduction of the history of ion exchange accidents begins by stating (Section 7.3.6.2) that only new energetic phenomena presented by this example is the resin exotherm and for the purpose of this example, a representative model of effects associated with the ion exchange exotherm will be assumed to be a thermal explosion. Factory Mutual defines a thermal explosion as "the result of an exothermic reaction occurring under conditions of confinement with inadequate cooling....the reaction rate and heat generation accelerate until the container fails due to overpressure". The Hanford cation exchange accident was reported to have resulted in the column failing from hoop stress due to a thermal explosion caused by an exothermic reaction.

The DOE Handbook DOE-HDBK-3010-94 in examples analyzes 5 different scenarios: all involve a spray release and burning of some resin that varies with the accident scenario. This is consistent with the investigation report of the Hanford accident scene. A spray release occurred from the rupture of the column and the burning release occurred from the charred resin. The amount of the resin charred to be included in the consequence is an engineering judgement based to some extent on the scenario. There was significant amount of uncharred resin reported after the Hanford incident (DOE-HDBK-3010-94, pg 7-41).

The TWRS-P ion exchange consequence calculation follows examples in the DOE Handbook that evaluate the more extreme condition of a resin exotherm in ion exchange column constructed out of steel thus allowing significantly higher pressures before vessel failure. The pressure generated by the resin exotherm has a significant effect on release fraction even greater than burning. If the degree of superheat is greater than 50 C but less than 100 C the associated ARF x RF is 0.07 or seven times greater than the release effected by burning (DOE-HDBK-3010-94 pg 7-43). In the TWRS-P analysis, the spray release fraction is roughly three times or 0.033 that effected by burning. (The 0.01 quoted in the statement of question only applies to the burning release fraction, see pg 4-163 of the ISAR) The difference between the value for spray release quoted from the DOE Handbook and the TWRS-P analysis is the different degree of superheat in the two analysis which directly affects the release fraction. Also in the TWRS-P analysis as in the case of the Hanford incident, the resin exotherm occurs following the initiation of the elution when the columns are fully loaded with cesium in solution leaving little on the resin to be subjected to charring. This maximizes the release because the release fraction is the highest when the column undergoes hoop stress failure. In conclusion, the mechanism modeled is a resin exotherm. It is consistent with DOE Handbook example analysis and as a result maximizes the release.

The basis for the ARF for the design basis earthquake, the CST pressurization and rupture, spray leaks from transfer lines, releases due to the hydrogen deflagrations, failure of the HLW Receipt

Tank and the LAW Receipt Tank and the release due to boiling of the cesium/technetium product tank are as follows:

Earthquake The source terms, ARFs and RFs used for the Earthquake analyses are the same as those used for the individual systems assumed to fail as a result of the earthquake. For instance, the contribution to airborne release from failure of the LAW receipt tanks is assumed to be the airborne release from failure of one tank, as given in Section 4.7.2.1, multiplied by the number of tanks (2).

Disposition

The BNFL response is acceptable.

A few systems were included in the earthquake analysis for which detailed analyses were not provided elsewhere in Section 4.7.2. The assumptions used to estimate their contribution to the earthquake source terms follows:

For both options:

Transfer line break: The assumed respirable airborne release from the pipeline break was 12 L Envelope B waste. The reference given, Hall 1996, estimated 12 L airborne respirable material from the pipeline spill analyzed for the TWRS SAR. The radionuclide composition of the Envelope B waste is the same as that used for analysis of the LAW receipt tank failure in Section 4.7.2.1.

For the HLW/LAW option:

Failure of the Cesium/Technetium Product Tank: Tank radionuclide inventory is 2 x 1017 Bq 137Cs and 9 x 1014 Bq 99Tc as given in Table 4-1 of the BNFL TWRS-P Hazard Analysis Report. Airborne Release Fractions and Respirable Fractions are the same as those used for the failure of the LAW receipt tanks in section 4.7.2.1.

LAW Receipt Tank: Rationale and assumptions used in the determination of the ARF are found on page 4-150

Cesium Product Storage Canisters: The earthquake causes seven product storage canisters fall and spill their contents. Rationale and assumptions used in the determination of the ARF are found on page 4-158.

Cesium Ion Exchange Column: The loss of services caused by the earthquake initiates an ion exchange exotherm and thermal excursion. The basis for the analysis of this accident and the ARFs are as previously described.

HLW Receipt Tank: Rationale and assumptions used in the determination of the ARF are found on page 4-155.

HLW Melter: The earthquake causes structural damage to the melter resulting in the loss of contents. The analysis of the release is based on the work of Randall and Yau (Randall, C.T. and W.W.F. Yau, "Maximum Cesium Release Assessment for DWPF Operations", DPST-83-1058, Rev 3, January 1987). A copy of this document has been made available. For completeness the inclusion of the semi-volatiles Ru-106, Te-125m and Sb-125 as performed in DWPF analysis is required. The inclusion of these radionuclides requires the improved flowsheets of the next phase of design.

CST Pressurization and Rupture: The rationale and assumptions for the ARF in this analysis are found on page 4-165 of the ISAR which references Section 4.4.2.3.1, "Venting of Pressurized Powders or Pressurized Gases Through a Powder, Pressure > 0.17 Mpa" DOE-HDBK-3010-94. The release fraction are based on the pressurized venting of TiO_2 and UO_2. TiO_2 and UO_2 are powders not intended to be retained in an ion exchange column like CST. Using the TiO_2 and UO_2 Rfs is conservative for the granular CST

Hydrogen Deflagrations: Hydrogen deflagrations identified in the binning process and tabulated in Table 4-31, "Summary of Flammable Gas Fire/Explosion Events" (ISAR pg 4-141), are an explosion in the HLW Vitrification Offgas Treatment System, an explosion in the ultrafilter used for dewatering Envelope D waste, and deflagration in the vapor space of the HLW Melter Feed Receipt Tank. The screening selection process indicated that the ultrafilter explosion and the explosion in the vapor space of the HLW Melter Receipt Tank may require additional analysis to determine the bounding accident in the flammable gas category because of the difference in the ARF for the ion exchange explosion and the hydrogen deflagrations. A review of the DOE Handbook indicates that the release fractions for explosion in the vapor space over solution or slurries as the case may be are low, in the range of 1E-04 (see Section 3.2.2.3.1 and 3.2.2.3.2) therefore the bounding accident selected was the Cs ion exchange which has a much higher ARF. Because of higher dose equivalent in the material at risk for the hydrogen deflagrations events identified in the screening, the ARF for these events need to be confirmed and dose equivalent estimated to be sure that the ion exchange explosion is the bounding event in this category. This is stated in the text (page 4-142) both the explosion in the HLW Receipt Tank vapor space and the ultrafilter need further quantification.

Question # 80 **Status** Acceptable

Cited Submittal Text Sections 4.7.1.2.2, 4.7.2.5 and 4.7.2.6.

Cited Reference BNFL submittal BNFL-5193-ISAR-01, Rev. 0, "Initial Safety Analysis Report A-4," dated January 12, 1998; Section 4.7.2.5 and 4.7.2.6, pages 4-162 through 4-167.

Evaluation Criteria DOE/RL-96-0003, Rev.0, "DOE Regulatory Process for Radiological, Nuclear, and Process Safety for TWRS Privatization Contractors," dated February 1996, section 4.2.2, "Contractor Input," states in part that the Initial Safety Assessment shall consist of the following documentation: 5) Description of potential design-basis events; and 6) Analysis of the potential design-basis events. The associated review criterion is to determine the acceptability of the results of analysis of representative design basis events (DOE/RL-96-0003, Rev.0, p. 6 of 35, Section 3.3.2, item 5).

Discussion Consideration of common mode failures during the accident analysis could result in an increase in the postulated release and consequences. For example, instead of having accidents that involve one ion exchange column or one Cs storage canister, consideration of common mode failures could involve multiple columns or canisters. The assumption of no common mode failure seems unconservative because it is highly probable that the columns may be lifted over other CST columns.

In paragraph 2 on page 4-135 of the ISAR, it is not clear whether the cooling systems for Tanks 4107A and B are independent, or if a single event could cause loss of cooling for both tanks. If a common cause event can cause the cessation of cooling to both tanks, the source term for this accident should be doubled, which may cause this event to be the bounding event for loss-of-confinement events.

Description 1. In estimating the radionuclide inventories associates with postulated accident releases, have common mode failures and common cause failures of multiple ion exchange columns or storage canisters for the accidents described in Sections 4.7.2.5 and 4.7.2.6 been considered in the analysis?
2. Please indicate whether a single event could cause the loss of cooling to both Tanks 4107A and B.
3. Please provide a complete discussion on the approach, determination, description, and analysis of bounding accidents involving to common mode and common cause initiators.

Contractor Response 1. Common mode/common cause failures were analyzed for these two accidents, but can't occur of the accidents analyzed in Section 4.2.7.5 and Section 4.2.7.6.

In Section 4.2.7.5, only one cesium ion exchange column can be loaded and ready for elution. The second column in series with the analyzed column has no significant loading and is not being eluted during the accident scenario (i.e., contains no nitric acid to initiate the event). The event initiator is the mistaken introduction of 12.2 M nitric acid (instead of 0.5 M acid) into a column containing degraded resin (instead of stable resin). The other set of columns are loading with cesium from the waste being processed and again have no appreciable loading and don't have any nitric acid flowing to them.

In Section 4.2.7.6, the canisters have relatively long loading times between sealing (K0104_REP_025_PRC, Process Description, Cesium as a Solid) so that pressurization because of poor drying of the CST were considered discreet events. When processing Envelope B Feed at contract maximums it requires about 12 days to load a canister. When processing Envelopes A and C feeds it takes about sixty days to load a canister.

2. A single event could cause the loss of cooling to both Tank 4107 A and Tank 4107 B. These tanks have a lower specific heat generation than does Tank 2710 which lead to its selection as the bounding accident analysis. Analysis showed that Tank 2710 took a relatively long time to reach 100 °C and established an equilibrium temperature at about 106 °C. Thus no analysis was performed for Tank 4107 A and Tank 4107 B.

3. The ISAR Appendix 1A - BNFL Inc. Overall Safety Approach provides a discussion of this approach for Part A and the planned activities for Part B. For common mode failures, Part A

activities addressed earthquakes, extreme weather, loss of off-site, external events, and fire. For common mode failures, Part A activities addressed individual events, but did not provided a robust quantifiable analysis. During Part B BNFL Inc. will address both types of failure in detail as the design progresses.

Disposition The BNFL response is acceptable.

Question # 81 **Status** Acceptable

Cited Submittal Text Sections 4.7.2.10.2 and 4.7.2.10.5

Cited Reference BNFL submittal BNFL-5193-ISAR-01, Rev. 0, "Initial Safety Analysis Report A-4," dated January 12, 1998; Section 4.7.2.10.2 and Section 4.7.2.10.5, pages 4-173 through 4-175 and 4-176 through 4-177.

Evaluation Criteria DOE/RL-96-0003, Rev.0, "DOE Regulatory Process for Radiological, Nuclear, and Process Safety for TWRS Privatization Contractors," dated February 1996, section 4.2.2, "Contractor Input," states in part that the Initial Safety Assessment shall consist of the following documentation: 5) Description of potential design-basis events; and 6) Analysis of the potential design-basis events. The associated review criterion is to determine the acceptability of the results of analysis of representative design basis events (DOE/RL-96-0003, Rev.0, p. 6 of 35, Section 3.3.2, item 5).

Discussion The earthquake scenario accident analysis in Section 4.7.2.10 provides an estimate of the consequences associated with four systems that would fail under earthquake conditions. As an accident mitigation, the discussion in Section 4.7.2.10.5 indicates that all of the systems are assumed to fail "in-cell," and that the ventilation systems and stack will be designed to withstand the design basis earthquake such that there will be adequately mitigated releases. However, the transfer line between tank 241-AP-106 and the TWRS-P facility will be outdoors, not in cell, and does not appear to be covered by the proposed safety components.

Description 1. For the earthquake scenario accident analysis described in Section 4.7.2.10, what are the consequences of the line rupture without mitigation?

2. For releases that will not go through the stack, what safety components are proposed for mitigation?

3. What safety classes would be assigned?

Contractor Response 1. The accident analysis used unmitigated releases from the waste transfer line break.

2. None of the releases from the DBE go through the stack. The stack only mitigates the release from non-seismic failures of the HLW receipt tank.

3. The designations of SSCs are found in Table 4-46 and Table 4-47.

Disposition The BNFL response is acceptable.

Question # 82 **Status** Acceptable

Cited Submittal Text Section 4.1.5.3 (Seismic hazard), p4-36, "Response spectra for the 200 East Area of the Hanford Site…… from the seismic hazard assessment"

Cited Reference BNFL-5193-ISAR-01, Revision 0

Evaluation Criteria RL/REG-97-11, Revision 1, Section 6.5 - Analysis of Design Basis Events

Discussion DOE Standards 1020 and 1023 caution the direct use of the Uniform Hazard Spectra (UHS) derived from Probabilistic Seismic Hazard (PSH) Study as the Design Basis Earthquake (DBE) Spectra. The DOE Standard 1023 outlines the process by which the UHS should be checked to determine the adequacy of the UHS for design purposes. It is indicated in the ISAR (Section

4.1.5.3, page 4-36) that such an adequacy check has been made. However no detailed information was provided nor was the study, which documented the results of the adequacy check, referenced.

Description

Please discuss the results of the adequacy study in detail including a discussion of what and how the requirements of DOE Standard 1023 were met. Please submit a copy of the study with your response.

Contractor Response

A copy of the referenced study was sent to the reviewer on February 26, 1998.

The de-aggregation and spectral check guidance in DOE-STD-1023 and 1020 is to insure that the UHS represents a broad banded design spectra. The check was primarily developed for the Eastern US sites where it was known that the LLNL and EPRI attenuation model were outdated. The UHS did not, therefore, result in an appropriate spectral shape. For Western US where there is more empirical data, it is much more likely that the "right" attenuation relationships can be determined. If the appropriate attenuation relationships are used for the PSH assessment, the UHS will include the appropriate breadth and amplification for the site. To this end, the most intense review of the Hanford Site PSH assessment, which included the UHS, was done by experts in the field of ground motion and current research in attenuation relationships. The PSH assessment was approved by DOE-HQ in 1997.

The Hanford Site soil properties assessed for the evaluation of appropriate attenuation relationships is addressed in Appendix A of WHC-SD-236A-TI-002, Rev 1A.

Separately it has been asked why there was a difference in the ash loading for the Hanford Site Canister Storage Building (CSB) and the TWRS-P Facility.

The response is that additional study has been completed to determine the risk reduction factor for ash-fall at Hanford since the submittal of the CSB safety analysis report. This information is summarized below and will be included in the TWRS-P Facility PSAR.

A study was performed to develop ashfall hazard for probabilities for use in design and evaluation of structural elements subjected to ashfall loads at the Hanford Site (Salmon 1996 [ISAR Chapter 13.0]). The design ashfall loads for SSCs with and without NPH safety functions are presented in SRD Volume II, Tables 4-1 and 4-2 respectively (SAP Question Response 12 and SRD Rev 1, draft). The ash depth at the appropriate probability is determined from ISAR Figure 4-20 and the load calculated assuming a 50% compaction ratio and an uncompacted ash density of 769 kg/m3 (48lb/ft3).

Design Basis Ashfall Criteria

NPH Safety Function	Ash Hazard Probability	Design Ashfall Load (kg/m2)
With	3.0 x E-04	61 kg/m2
Without	1 x E-03	24 kg/m2

Disposition

The BNFL response is acceptable with the following comment:

An initial review of the referenced study indicates that the uniform hazard spectra provides a suitable enveloped spectra in accordance with DOE Standard 1023

Question # 83 **Status** Unacceptable

Cited Submittal Text

Section 4.7.2.2.2 - Source Term Analysis

Cited Reference

BNFL-5193-ISAR-01, Revision 0

Evaluation Criteria

RL/REG-97-11, Revision 1, Section 6.5 - Analysis of Design Basis Events

Discussion

BNFL has characterized the ISAR accident analysis approach to be a conservative one (page 4-121) where accidents are analyzed unmitigated, due considerations are given to the uncertainties in the analysis and engineered or administrative controls are applied to mitigate accident consequences so that the calculated exposures are far below those listed in the radiological or chemical standards (page 4-119 and120). Active engineered features that play a mitigative role are ignored in the preliminary analysis (page 4-125).

BNFL seems to have deviated from the above approach in performing some of the accident analyses. For example the HLW receipt tank failure analysis was performed using a reduced plutonium and americium concentration resulting in a lower dose. This reduction is based on an existing criticality prevention specification that prohibits the transfer of solutions with the plutonium concentration specified by the contract (the specification is not referenced). Two issues arise with this approach which are: 1) BNFL may not be conforming to the contract as the contract appears to require that a given radionuclide inventory to be used as the basis for the TWRS-P design, and 2) the equipment or approach to be used to dilute the Envelope D feed prior to transfer to the HLW receipt tank (which constitutes an active engineered feature) is unclear (and perhaps unknown).

There are other examples where BNFL seems to have deviated from the conservative approach outlined above apparently without justification. As an example, the contents of the HLW receipt tank are assumed to be a slurry. The selected ARF and RF values for the assumed slurry is a factor of 2.5 lower than the values used for the LAW receipt tank analysis. The contents of the LAW receipt tank are assumed to be an aqueous solution. The basis for treating the HLW tank contents as a slurry is not discussed and it is not clear that it is appropriate to treat the HLW contents as a slurry. Also, both the HAW and LAW receipt tank analysis use ARF and RF data based on a spill height of less than 3m. This data may not be appropriate for analysis of radionuclide release from tank rupture during a seismic event. The forces generated during a seismic event that are sufficient to break the tank may also increase the ARF due to pool turbulence compared to a tank break/spill. Use of the spill data from the DOE Handbook for radionuclide release during a seismic event needs to be justified.

There are also instances where BNFL seems to deviating from design conservatism. For example, for the loss of cooling of a Cs product storage tank resulting in tank boiling, BNFL states that sufficient time exists to restore tank cooling (11.6 days) by some unspecified approach. No mention is made of the approach to be used to restore tank cooling or whether any DCI or II SSCs are needed. In the case of the transfer line where the potential for spilling a large amount of radioactive fluid exists if the line breaks, no mention is made of whether this line will be protected against a seismic event.

In short, BNFL has made the appropriate statements about performing unmitigated accident analyses and applying design conservatism, but in some instances, has deviated from that goal. BNFL should review the approach to designating SSC design classification with the perspective of developing a reasonable but conservative design, considering both the accident analysis results and their design experience.

Description

1. Discuss the approach to designating SSC design classification with the perspective of developing a reasonable but conservative design, considering both the accident analysis results and their design experience.
2. Justify the use of the criticality prevention specification to reduce the plutonium and americium inventories in the Envelope D feed. Provide a reference to this specification.
3. Discuss the impact on the dose analysis and SSC design classification if the radionuclide inventory is not adjusted per the criticality specification.
4. Explain the approach to be used to achieve dilution of Envelope D feed to meet the criticality specification. Who is responsible for this activity?
5. Discuss the apparent contradiction in the stated approach of an unmitigated and conservative accident analysis and the approach used in the HLW receipt tank accident where mitigative features are apparently applied to reduce the plutonium and americium source terms.
6. Justify the ARF and RF values selected from the DOE Handbook given that the seismic event may result in pool turbulence causing higher releases.

Contractor Response

1-5. BNFL Inc. used the concentration maximum for plutonium concentration and solids concentration for the analysis of the criticality. On further review of the loss of containment accident for the HLW receipt, BNFL Inc. realized that use of these parameters for the inventory of americium-241 led to an extremely large over estimation of the MAR. For establishment of americium inventory only, BNFL Inc. limited the transfer of Envelope D to the tank farm criticality specification.

Furthermore the loss of confinement accident for either seismic or non-seismic events doesn't consider the coincident failure of the tank farm criticality program. The HLW receipt tank is designated as SDC and Seismic Category I which is the most protective designation for SSCs.

6. The ground motion caused by an earthquake is expected to be of short time duration with respect to the progress of the failures it causes. The ground motion causes the tank failure, but stops before very much of the liquid has spilled. Therefore, no significant contribution to the

airborne respirable release from the earthquake is expected from the effect of the ground motion on the spilled pools.

Disposition

The BNFL response is unacceptable for the following reason:

For questions 1 through 5, BNFL has not answered the questions. In the response, BNFL has stated that they did the analysis using the concentrations in the contract and then reduced the Am-241 concentration based on the tank farm criticality specification because they felt that the MAR was too high. This approach is not acceptable. BNFL needs to use the concentrations stipulated in the contract. If BNFL believes that the contract values are too high, then this question needs to be resolved with DOE.

For Question 6, the point of the question may not be clear. During the earthquake, the tank contents may be dumped onto the floor from splitting the side of the tank. The thrust of the question is that increased turbulence from dumping the tank contents during the earthquake may cause the ARF to be higher. This possible lack of conservatism needs to be considered in calculating dose consequences or assigning safety classification.

Question # 84 **Status** Unacceptable

Cited Submittal Text

Section 4.7.1.2.5, Discussion of Events 35, 36, and 37
Section 4.7.1.2.3, Fire

Cited Reference

BNFL-5193-ISAR-01, Revision 0

Evaluation Criteria

RL/REG-97-11, Revision 1, Section 6.5 - Analysis of Design Basis Events

Discussion

Events involving fires or steam explosions are dismissed principally based on analysis performed at other facilities performed at Hanford, Savannah River or West Valley. For example, HEPA filter fires are not analyzed because the potential for ammonium nitrate precipitation followed by combustion is "low" (See pp 4-136 and 4-137). Similarly, West Valley analyses are used to show that a steam explosion in the melter is "beyond extremely unlikely." It may be that these analyses were performed to support risk assessments at existing facilities rather than supporting the SSC classification of a facility to be built. In this sense, these analyses may be "best estimate" analyses to obtain realistic risk estimates rather than conservative analyses used for SSC classification.

Description

1. Explain the basis for not performing an evaluation of the impact of a filter fire based on the presumption that the potential for ammonium nitrate precipitation followed by combustion is "low".

2. Categorize the "low" potential in terms of the frequency bins defined in the accident analysis.
3. Provide a brief summary of these analyses.
4. Provide information on the SSC design classification of components at the other facilities treated in these analyses.
5. Justify the applicability of the analyses performed for other facilities at Savannah River, West Valley and Hanford analyses to setting SSC design classification at the TWRS-P facility.

Contractor Response

The basis for not performing an evaluation of the impact of a filter fire is based on the absence of conditions for accumulating fuel source, either ammonium nitrate or an organic in the filter. As stated in the text the tank farms that are supplying the feed to TWRS-P have discounted ammonium nitrate in the filters as a safety hazard because of its absence and because of the absence of severe conditions required for an event to occur. The absence of conditions for ammonium nitrate precipitation in tank ventilation system filters was noted in safety studies supporting the TWRS Basis for Interim Operation (HNF 1997). The high alkaline nature of the waste does not support the precipitation of ammonium nitrate from the waste. Ammonium ion in solution is orders of magnitude lower than needed for precipitation; the equilibrium is toward ammonia dissolved in the supernate and slowly released as a vapor (Borscheim 1991). Measured concentrations of nitrogen dioxide in tank vapor space gases are much lower than required to produce sufficient ammonium nitrate to completely plug a HEPA filter in a year (Pederson 1994).

The conditions, temperature, confinement, quantity, and initiators required to produce a rapid exothermic reaction involving ammonium nitrate are not present in any of the Hanford waste tanks. The necessary conditions as reported in the TWRS safety studies are that the ammonium nitrate present as a confined charge requires a temperature of 260 C to 300 C and a pressure of 2500 psi to explode. The material, if pure, will burn at a temperature of 500 C. And finally this report states that a completely plugged HEPA filter has been estimated to contain at least a factor of 30 less ammonium nitrate than required to a sustain detonation (Pederson 1994).

An supporting analysis by a Hazard Research Corporation study of the Purex Plant filter confirmed the severe conditions required to ignite ammonium nitrate. In test at the Denville, NJ, reported these significant findings:

- The ammonium nitrate occluded on the prefilters could not sustain a detonation and would not be capable of thermal runaway reaction even if subjected to high temperatures (170 C, the melting point of ammonium nitrate) for extended periods (24 hours) in stagnant air

- Irradiation of organic (plant solvent condensed in the filter) results in decomposition into lighter, volatile products which diffuse rapidly out of the prefilter beds and further reduces the possibility of reaction

- Even under high confinement and initiating energy conditions much more severe than are credible in the Purex prefilters, approximately 8.7 times the ammonium nitrate in the No. 1 prefilter would be required to sustain a detonation. (The No. 1 prefilter was estimated to contain up to 7000 pounds of ammonium nitrate in the upper two feet of the bed.)

- The prefilter matrix will not detonate, even with shock loadings orders of magnitude greater than could be attained mechanically as a result of a solvent fire.

- Pressures of about 3 Kg/cm2 (43 psig) and temperatures of about 240 C are required for a thermal explosion of ammonium nitrate sensitized with wax (hydrocarbon) or chloride. These conditions are not credible in the Purex filters.

- Sustained sudden impingement of very high temperature vapor/air or flames would only melt and decompose the ammonium nitrate even at concentrations 7.5 times the estimated value.

Disposition

The BNFL response is unacceptable for the following reason:

The information provided in the response shows that the filter fire is not credible. The background information was not reviewed.

The last part of the response concerning the use of analyses from other facilities is unacceptable. The point of the last part of the question is that BNFL is using analyses from other facilities without any justification or apparent review of applicability to the TWRS-P facility. It could be that the approach and assumptions used in these analyses may not be transferable to the TWRS facility. The applicability of these analyses to the TWRS-P facility needs to be demonstrated

Question # 85

Status Acceptable

Cited Submittal Text

Section 4.3.1.8 - LAW Glass Melter
Section 4.3.2 - Melter Offgas Treatment Systems

Cited Reference

BNFL-5193-ISAR-01, Revision 0

Evaluation Criteria

RL/REG-97-11, Revision 1, Section 6.5 - Analysis of Design Basis Events

Discussion

Section 4.3.1.8 states that a "cold cap" of unreacted feed components is formed on the surface of the molten glass that inhibits the release of volatile components from the glass. Section 4.3.2 states that a fraction of the feed components (presumably semi-volatile components) are recycled back to the melter from the offgas system.

Description

1. Provide a description of the "cold cap" in the glass melter.
2. Discuss the role of the cold cap in inhibiting the release of semi-volatile radionuclides.
3. Include a discussion on whether the formation of the "cold cap" has been observed in operational experience or in laboratory tests.
4. Discuss whether any accumulation of radioactive material occurs in the offgas system as a result of recycling semi-volatile components.
5. Has radionuclide accumulation in the offgas system been considered in the accident analysis?

Contractor Response

1. The top of joule heated melters may have up to 90% of their surface covered with an oxide crust known as the cold-cap. A 90% coverage of the melt surface by the cold-cap allows the

melter operator to maintain a stable melting process while maximizing the waste glass production rate. Maintaining a constant cover of the melt surface automatically balances the feed rate with the melting rate.

2. From the EPA "Vitrification Technologies for the Treatment of Hazardous and Radioactive Waste:"

In cold-top glass melters, metal vaporization has traditionally been solved by the creation of a "cold-top" layer or crust on the surface of the melt. This layer is formed by the incoming feed as it floats on the liquid melt, warms to melt temperature, and eventually dissolves into the melt. Because it is cooler than the melt, metals migrating to the melt surface may be trapped in the cold-top and sink back into the melt to be possibly incorporated into the glass.

3. As discussed above, the formation of a cold-top is a commonly observed phenomenon in joule heated melters. One paper discussing the laboratory measurement of glass melting rates "Laboratory Studies for Estimation of Melting Rate in Nuclear Waste Glass Melters," by Dong-Sang Kim and Pavel Hrma addresses the ability to develop small scale tests for predicting cold-cap formation at large scales. This paper was presented in Ceramic Transaction, Volume 45 edited by Dennis Bickford, Steven Bates, Vijay Jain, and Gary Smith.

4. The semi-volatile components do not accumulate in the offgas. The offgas system immediately removes the semi-volatile components in the melter quencher. The solution from this quencher is recycled to pretreatment so that semi-volatile components can be returned to the melter. The section of ducting between the melter and the quencher has special engineering features to prevent the deposition of condensible components from the melter offgas and other design features to remove any accumulation.

5. Because of the features described above no accumulation of radionuclides occur in the offgas system beyond the quencher and the conservative assumptions as to the melters inventories include the short section of ducting between the melter and the quencher.

Disposition The BNFL response is acceptable.

Question # 86 **Status** Acceptable

Cited Submittal Text Section 4.7.1.2.2 (page 4-1.3.4) - Loss of Confinement (Gas or Particulate Release)

Cited Reference BNFL-5193-ISAR-01, Revision 0

Evaluation Criteria RL/REG-97-11, Revision 1, Section 6.5 - Analysis of Design Basis Events

Discussion The approach used to compute the inhalation dose equivalent for Events 7, 9, and 11 involving the release of melter gases is unclear.

Description

1. Clarify the approach used to determine the inhalation dose equivalent for these events.
2. Explain the approach to obtaining the releases that result in an inhalation dose equivalent as different as 2.4x10 6 Sv and 320 Sv.

Contractor Response The following paragraphs provide the approach and assumptions used to derive the inhalation dose equivalent values for the melter offgas events, listed on Table 4-30 as Events 7, 9 and 11. As stated in the text of Section 4.7.1.2.2, Event 7 involves loss of HEPA filtration of the offgas stream, and it is assumed that the unfiltered release continues for 24 hours. For Events 9 and 11 the quantity of gas at risk for release is taken to be the volume in the melter free space at the time of the accident.

Source Term Values used for Ranking PHA Events

Event Number - 7, 11
Description Melter Offgas (24 hour release)
Source Term
1.5 x E+14 Bq 137Cs
4.3 x E+12 Bq 90Sr
5.4 x E+11 Bq 99Tc
6.6 x E+09 Bq TRU

Calculation Parameters- Source Term Values are given as throughput quantities/day. Therefore, those values are used as the total for the 24 hour release.

Event Number - 9
Description Melter Offgas, (release from melter gas space)
Source Term
2.0 x E+10 Bq 137Cs
5.7 x E+08 Bq 90Sr
7.2 x E+07 Bq 99Tc
8.8 x E+05 Bq TRU
Calculation Parameters- Daily radionuclide throughput values are as given for events 7 and 11.
- Volumetric flow through the offgas system is 4.8 x 104 cu. m/day.
- Free volume of the melter is estimated from melter dimensions minus glass volume to be 6.4 cu. m. The internal melter height was not given, so was estimated from external dimensions to be 3.2 m.

Disposition

The BNFL response is acceptable but subject to the following:

For events 9 and 11, explain why only the equivalent of a single melter free volume of gas is released. Why doesn't the release continue given the daily gas flow of 4.8x104 m3/day? Also note that event 11 should be included with event 9 (as in the ISA) instead of event 7 (as in the response). These issues will be pursued in future interactions between the RU and BNFL.

Question # 87 Status Unacceptable

Cited Submittal Text

See above.

Cited Reference

BNFL ISAR, BNFL-5193-ISAR-01, Section 12, "Definitions," and Section 4.8, "Controls for Prevention and Mitigation of Accidents"

Evaluation Criteria

DOE/RL-96-0003, Section 3.3.2, Item 8.f, requires an evaluation of: "The adequacy of the outlines of various plans, programs, and requests that will be generated and implemented in Part B."

Discussion

DOE/RL-96-0006, Section 4.3.1.6, specifies that facility operations be conducted in accordance with approved TSRs. DOE/RL-96-0006 defines Technical Safety Requirements (TSRs) as follows:

Those requirements that define the conditions, the safe boundaries, and the management or administrative controls necessary to ensure the safe operation of the facility, reduce the potential risk to the public and facility workers from uncontrolled releases of radioactive materials, and from radiation exposures due to inadvertent criticality.

The definition for TSRs in the BNFL ISAR is as follows:

Those requirements that define the conditions necessary to ensure the public radiological and chemical exposure standards of the SRD are not exceeded for credible events. Technical Safety Requirements (TSR) are established to ensure that a process variable, design feature, or operating restriction that is an initial condition (i.e., the assumed facility state) for an accident is maintained. TSRs are also established to ensure that structures, systems, and components credited for meeting the public exposure standards will function when called upon to prevent or mitigate credible events. Changes to the TSRs can only be made upon approval of the regulator.

This change to the definition of TSRs results in a significant reduction in the scope of TSRs. Under the BNFL definition, TSRs would not be established to address worker or co-located worker safety. In Section 4.8 of the ISAR, BNFL describes administrative controls that are referred to as "Licensee Controlled Requirements (LCRs)" that are similar to TSRs. However, LCRs are not subject to the same commitments as TSRs. For example: 1) Changes to LCRs do not necessarily require Regulatory Unit approval prior to implementation, and 2) reporting requirements are not equivalent for LCRs.

Description

What is the rationale for deviating from the scope of TSRs established in contractual requirements?

Contractor Response

One of the BNFL objectives in pursuing the contract for the processing of mixed wastes from the Hanford Tank farm was to develop innovative concepts for dealing with regulatory issues. This was driven, in part, by the information that the responsibility for regulation of the facility might be transferred from the DOE to the NRC. Therefore, many NRC regulations and guidance documents were reviewed during the development of the SRD. In particular, BNFL Inc. examined changes to 10 CFR 50.36 regarding the scope of items subject to limiting conditions for operations in the technical specifications. As with the TWRS-P Project, the purpose of the technical specifications is to assure that the adequate protection of the health and safety of the public by the safe operation of the facility and by the functioning of required structures, systems, and components in response to accidents. Each of the four criteria specified in 10 CFR 50.36 are based on the protection of the health and safety of the public. Criterion 1 and Criterion 4 are specific to reactor vessel design bases accidents and do not relate to the mission of the TWRS-P Project. BNFL Inc. decided that the other two were applicable and should be included in the definition of the technical safety requirements for the TWRS-P Facility.

In the implementation in the new standard technical specifications, many requirements originally specified in the technical specifications, and under the control of the NRC, were relocated to documents other than the technical specifications, typically the FSAR. This relocation of the requirements does not obviate the responsibility of the licensee to operate the facility in compliance with License or the FSAR. It does however, allow the licensee to evaluated proposed changes and to implement those changes under the provisions specified in 10 CFR 50.59. This regulation is consistent with the USQ process implemented at DOE facilities. This allowed licensees, in specific situations, to make changes to the facility, without prior regulatory approval absent the identification of an USQ.

BNFL, Inc. reached the decision that adequate safety could be provided, while maintaining costs by reducing regulatory involvement in some aspects of the project consistent with the regulatory approach taken for changes at commercial nuclear power plants.

Disposition

The BNFL response is unacceptable for the following reason:

BNFL's interpretation of Nuclear Regulatory Commission requirements and practices related to commercial nuclear power plants does not address the issue of conformance to DOE/RL-96-0006 as is relates to TSRs. Consistent with DOE/RL-96-0006, the reviewers conclude that facility operations must be regulated by approved TSRs and that these TSRs define the conditions, the safety boundaries, and the management or administrative controls necessary to ensure the safe operation of the facility. This mater will be pursued during future interactions between the RU and BNFL..

Question # 89 **Status** Acceptable

Cited Submittal Text

Section 2.0.

Cited Reference

BNFL-5193-ISAR-01, REV.0, Initial Safety Analysis Report, Section 2.0, Management Organization.

Evaluation Criteria

DOE/RL-0003, Paragraph 4.2.2, Paragraph 4.2.2, Item 3), page 13 of 35, requires that the Contractor's submittal consist of

" ... 3) An assessment of compliance with the approved SRD and ISMP".

Discussion

The referenced section, Section 2.0, of the ISAR insufficiently addresses the relationships, roles, responsibilities, accountabilities, and authorities of not only the management organization but also of the contractor support organizations. Examples include the following:

Section 2.1, Organization and Administration, does not address the relationship between BNFL (plc) and BNFL (Inc.) with respect to administration of the TWRS-P contract, including specific relationships between the safety committees and "corporate support."

Section 2.1.1 excludes discussion of the roles and relationships between the support organizations and BNFL (Inc) and among the individual support organizations.

General requirements (i.e., education, experience, skills, etc.) necessary for positions and/or sections are not identified.

Relevant experience in the design, construction, and operation of facilities similar to TWRS-P is not cited.

Discussion of these items, in detail is necessary to demonstrate a thorough understanding and incorporation of Integrated Safety Management principles. The contractor acknowledges that further information will be developed during Part B of the TWRS-P Project and presented as part of the PSAR (Authorization to Construct Request).

Description

Question: Provide evidence that the relationships, roles, responsibilities, accountabilities, and authorities of all principal organizations participating in Part B activities that are important to safety.

Contractor Response

(As restated by Mike Terry 373-9244)

In the context of Integrated Safety Management, provide evidence of relationships, roles, responsibilities, accountabilities, and authorities of all principal organizations participating in Part B activities that are important to safety: identify necessary personnel qualifications for positions or sections and describe specific relevant corporate experience in design, construction, and operation of facilities similar to TWRS-P.

The ISAR provides information about the safety roles and responsibilities, accountabilities, and authorities of the organization; the ISMP Chapter 9.0 Table 9-5 provides information about the key safety-related activities in every phase of the Project and in Table 9-5 relates those activities back to specific functional areas. The functional areas track back to the ISAR Figure 2-1 and Figure 2-2 organizational charts to show the lines of responsibility that flow down from the General Manager to the Project Manager and area leads. These organization charts also show an interface between certain positions in the Project and associated corporate support, e.g., the interface between the TWRS-P ES&H lead and the Vice President of ES&H.

General requirements exist at the corporate level for project positions, or groups of positions. The requirements state the minimum level of education, the skills specific to the task, and relevant experience needed. In addition, the position descriptions for the TWRS lead positions have been established and state the overall responsibility for each position and the minimum qualifications and experience needed. Certain positions, such as ES&H positions, require certifications, or state mandatory training requirements.

One example of a TWRS position description is the TWRS Operations Manager, who has specific responsibilities: provide operational input to design; serve on the Design, Technical and Safety committees; develop inactive/active commissioning plans; manage commissioning work; develop operational capability, including procedures and practices; conduct workforce recruitment and training and labor relations.

The Operations Manager needs to have experience from Sellafield or Hanford operations, operate at a Plant Manager level, have proven experience in each of the specified areas of responsibility (above) at a complex nuclear processing facility.

The following discussion responds to the specific questions.

There is no specific relationship between BNFL Inc. and its parent company. The corporate support for TWRS comes from the Executive Committee, as described in the ISAR 2.2, and includes technical support from the Vice President of ES&H.

Disposition

The BNFL response is acceptable.

The specific roles of BNFL and its support organizations is described in ISMP Table 9-5; BNFL Inc. has overall line responsibility for health, safety and environment and is accountable for creating and maintaining a safety and healthy workplace and protecting the public and environment.

The relevant experience the BNFL Team brings to TWRS-P is cited in the ISMP Table 1-1.

BNFL designed and operated WVP, Duratek Melter, SIXEP, EARP, WEP, and THORP; its facility construction manager served as the architect engineer and field engineer on DWPF and designed WVDP; BNFL engineers have been involved in the processing of waste at VSL, B Plant, and SR-ITP.

Question # 90 **Status** Acceptable

Cited Submittal Text None.

Cited Reference TWRS-P Project Initial Safety Analysis Report, BNFL-5193-ISAR-01, Rev. 0.

Evaluation Criteria 4.1.2 The adequacy with which the hazards, including process hazards, attendant to the Contractor's proposed activities have been assessed and controlled. Item E, page 12 of DOE/RL-96-0003.

Discussion On page 4-71 of ISAR Section 4.3.1.3, "Entrained Solids Removal by Ultrafiltration," it is stated that reagents are added to precipitate strontium and TRU elements... Continuous circulation through a crossflow filter removes the entrained solids and precipitate." The precipitated solids are then returned to DOE or mixed with feed for processing by the HLW Melter without describing the storage of this material. In Figures 4-28 and 4-29 of the ISAR, on pages 4-69 and 4-70, respectively, it is shown that material goes into a 60-day buffer tank. It appears that the intent of this tank is to store an undescribed maximum quantity or concentration of potentially concentrated TRU.

Description What is the potential for an inadvertent criticality in the TRU storage tank?

Contractor Response The low-activity waste (LAW) Envelope C feed is the only waste envelope that requires separation of Sr-90 and TRU elements. The TWRS Privatization contract specification 7, Low-Activity Waste Envelope Definition, states the maximum TRU concentration in the Envelope C feed is 3E+06 Bq (8.11E-05 Curies) per mole sodium in the LAW feed. The U.S. Department of Energy has sampled and analyzed candidate LAW Envelope C feed (ref. DOE/RL letter number 97-WDD-070, dated May 2, 1997 and WHC-SD-WM-ER-545, revision 1). These sample analyzes indicate Am-241 constitutes approximately 80 to 90% of the TRU present in the LAW Envelop C feeds.

BNFL separates the Sr-90 and TRU from LAW Envelope C feeds by co-precipitation using strontium nitrate and ferric nitrate. The iron added to precipitate the TRU also acts as a neutron poison, but BNFL has chosen not to consider this when evaluating criticality. The Sr/TRU precipitate is assumed to be concentrated to 50 wt% slurry using ultrafiltration and stored in vessels V1108 A and V1108 B (LAW only option) or vessel V4103 (combine HLW/LAW option). Concentrating the precipitate to a 50wt% slurry is a conservative assumption. The composition of plutonium present in these vessels would be a maximum of 0.0067 grams per liter (see Waste Product and Secondary Wastes Plan, BNFL-5193-PSW-01, section 3.4), based on the maximum plutonium content of the LAW Envelope C feeds and concentration of the precipitate to 50 wt% slurry. The criticality assessment conducted by BNFL (ISAR chapter 6) assumed a plutonium concentration of 0.5 grams per liter as a conservative case. Chapter 6 of the ISAR shows this to be safe, with wide margins of safety to prevent criticality.

Disposition The BNFL response is acceptable but subject to the following:

BNFL provided information on the concentration of Pu in the TRU storage tank. This information is based on a reference which was not available at the time of the ISAR review. This information along with the inventory of other fissile isotopes and a discussion of accident conditions in the TRU storage tank, which could impact criticality safety, should be provided in future safety documentation.

In chapter 6 of the ISAR,, BNFL committed to a future evaluation of criticality safety in the LAW process. The evaluation will encompass fissile material inventory in the TRU storage tank and accident conditions affecting criticality safety in the TRU storage tank. When they become available, these evaluations will be reviewed by the RU.

Question # 91 **Status** Acceptable

Cited Submittal Text Section 4.3, figures 4-28 and 4-29.

Cited Reference BNFL-5193-ISAR-01, Revision 0

Evaluation Criteria RL/REG-97-11, Revision 1, Section 6.5 - Analysis of Design Basis Events

Discussion

In Figures 4-28 and 4-29 of ISAR Section 4.3, various waste streams are identified as being returned to DOE. These include entrained solids, Sr/TRU solids and technetium (LAW-only) in slurry or liquid forms. Interim storage of these materials at the proposed facility is also as slurry of liquid. This raises confinement and safety concerns regarding the potentially large inventories of highly radioactive materials that would be in storage at the facility. .

Description

Please address the safety aspects of this scenario.

Contractor Response

The expected inventories of the tanks storing Sr/TRU precipitate and entrained solids are given in Table 4-1 of the BNFL TWRS-P Hazard Analysis Report. The entrained solids are stored for return to DOE for both options. The inventory of the storage tanks for all LAW envelopes is at least a factor of 150 less than the LAW receipt tank that was analyzed. Therefore, its failure is bounded by the LAW receipt tank failure analysis.

Sr/TRU precipitates and technetium product are stored only for the LAW only option. For the HLW/LAW combined option, they are routed for blending with the Envelope D waste. The inventory of the Sr/TRU precipitates tank as given in Table 4-1 of the Hazard Analysis Report is of the same order of magnitude as the LAW receipt tank. Consequences of its failure would be expected to be comparable to the LAW receipt tank failure consequences. The event of its failure should also be considered as one requiring mitigation for protection of the worker and should be added to table 4-44. The inventory of technetium product stored before return to DOE is not expected to be enough that the failure of that tank would challenge exposure limits.

The potential for failure of these tanks will be further considered in the Part B analysis.

Disposition

The BNFL response is acceptable with the following comment:

The requested information was provided. Note that the safety class design designation may be applied to other tanks in the TWRS-P facility. This decision will be further considered during the Part B effort.

Question # 92 **Status** Unacceptable

Cited Submittal Text

Section 4.2.1, page 4-48
Section 4.3.1.1, page 4-71
Section 4.7.1.2.1
Section 4.3, Figures 4-28 and 4-29.

Cited Reference

BNFL-5193-ISAR-01, Revision 0

Evaluation Criteria

RL/REG-97-11, Revision 1, Section 6.5 - Analysis of Design Basis Events

Discussion

On page 4-48 of Section 4.2.1 of the ISAR and on page 4-71 of Section 4.3.1.1, only a break of the LAW transfer line is postulated in the accident analysis without any discussion of an accident involving a HLW transfer line break. An accident involving a HLW line break should be evaluated.

Accidents involving transfer lines used to conduct process wastes in slurry or liquid form back to DOE apparently have not been evaluated. These lines will contain slurries or liquid containing highly concentrated radionuclides.

Description

1. Please provide an evaluation of a HLW transfer line break, and
2. Provide an evaluation of an accident involving a break in a transfer line used to return liquids and slurries to DOE.

Contractor Response

1. For non-seismic events, the HLW line case is bounded by the assumptions used for the LAW feed line case.

2. BNFL Inc. uses the same line for transfer of solutions and slurries to DOE as it uses to transfer LAW feed to the facility. A non-seismic induced transfer accident is bounded by the current accident analysis involving Envelope B waste. The line is doubly encased and buried six feet below the surface. BNFL Inc. has assumed a pool release at the surface for the liquids involved in the transfer

For the seismic analysis, the entire inventory of the slurries accumulated for transfer to DOE has been included in analysis of the facility during the DBE. BNFL Inc. didn't double count any inventories in performing the analysis during the DBE. Thus a separate transfer accident during the DBE is not warranted.

Disposition

The BNFL response is unacceptable for the following reason:

It is not clear from the response that the HLW line case is bounded by the assumptions used for the LAW feed line break (Item 1). The HLW inventory is limiting from a dose perspective. Furthermore, the possibility of simultaneous failure of all four pipes during a LAW/HLW transfer has not been addressed. These issues will be pursued during future interactions between the RU and BNFL.

Question # 93 **Status** Unacceptable

Cited Submittal Text None.

Cited Reference

Section 4.1.7, of BNFL-5193-ISAR-01, "Nearby Facilities and Transportation"
Section 2.1.3.1, BNFL-5193-HAR-01, "Nearby Facilities and Transportation"

Evaluation Criteria

DOE/RL-96-0006, Section 4.2.1.1, " The facility should be designed for a set of events such as: normal operations, including anticipated operational occurrences, maintenance, and testing: external events; and postulated accidents."

DOE/RL-96-0005, Section 3.3.2, AThe adequacy with which the hazards, including process hazards, attendant to the contractor's proposed activities have been assessed and controlled.

Discussion

The ISAR in Section 4.1.7 directs the reader to Section 2.1.3 of the Hazard Analysis Report for a discussion of the hazards from nearby facilities and transportation. Section 2.1.3.1 discusses the adjacent 200 East Area TWRS Tank Farms as a potential external accident source. The HAR states: "Significant accidental releases of radioactive or hazardous materials from other facilities could lead to the evacuation of the TWRS-P facility operating personnel." Evacuation is not the only potential consequence. In the past, releases have occurred in the waste tank farms that have required personnel to "take-cover" within the adjacent facilities and reduce or curtail supply ventilation. Such events could cause a shutdown of the supply ventilation to the TWRS-P Facility.

Although the hazards from adjacent facilities are discussed, there is no evaluation of the impact that such accidents may have on the TWRS-P Facility.

Description

1. Has the impact caused by an event at adjacent DOE waste tank farms (e.g., airborne release from a waste tank farm spill into the TWRS-P supply ventilation system) been considered in the hazards analysis?
2. What happens when the corrective action required to respond to such a event causes a shut-down of a SSC important to safety?

Contractor Response

1. The impact of events in tank farms has not yet been analyzed. This will be done in Part B. It is also recognized that if there is a second waste treatment facility, it may represent a greater risk to the BNFL TWRS-P Facility than tank farms. At the time of the preparation of the Hazard Analysis Report and the Initial Safety Analysis Report, there was not data available to identify and assess the hazardous situations that the second facility would present to the TWRS-P Facility.

2. None of the important to safety systems or components identified to date would be affected by an external event at another facility requiring shutdown of the system or component. Should the HVAC system be required to achieve compliance to the operator exposure limits of SRD Safety Criterion 4.3-7 for an external event, options exist such as designing the system so that shutdown is not required (e.g., use of filters on HVAC intakes).

Disposition

The BNFL response is unacceptable for the following reason:

Although it is understandable why hazards for a facility which is not as yet designed would not be included in the Part A hazards analysis, the lack of analysis of impacts from an immediately adjacent facility (i.e., 200 East Tank Farms) where the hazards and accidents have been very well characterized and reported seems to be an oversight. Although those impacts may turn out to be minor in comparison to those caused by other events, they should have been considered. The commitment to perform impact analyses for external events, including those potential events from the DOE safety analysis for the waste tank farms, is a contractor commitment which will be reviewed by the RU as part of the PSAR evaluation.

Question # 94 **Status** Acceptable

Cited Submittal Text

2nd para "The selection of candidate accident scenarios for detailed analysis were made primarily from the hazardous situations having the highest potential consequences if unmitigated as identified by the PHA teams."

3rd para "The fault schedules were for all events assigned by the PHA teams as consequence Category 3 or 4 either the worker or public."

Cited Reference

BNFL-5193-ISAR Section 4.6.2.2 Accident Selection (page 4-116)

Evaluation Criteria

RL/Reg-97-11, Section 6.3, Hazards Assessment and Controls

Discussion

The above referenced text states that all consequence level 3 and 4 would be addressed in the ISAR accident analysis. However, the following consequence level 3 or 4 events from the SRD HAR were not addressed in the ISAR accident analysis (this is based on partial review against SRD HAR. No rationale for this omission is explained in the ISAR.

Event ID 3200/140 (SRD Page 5-134):
Electrical fire consequence for the workers is 3.

Event ID 3200/265(SRD Page 5-138):
LAW/HLW Glass melter removal consequence for the workers is 4.

Event ID 3200/116(SRD Page 5-155)
LAW/HLW Glass melter fire consequence for the workers is 3.

Event ID 1614776/275 (SRD Page 5-247)
Diesel fuel fire consequence for the workers is 3.

Event ID 1614775/430 (SRD Page 5-291)
Cs loading consequence to workers is 3.

Event ID 1614775/439 (SRD Page 5-290)
Cs line event consequence to workers is 3.

Event ID 1614775/389 (SRD Page 5-292)
Cs Line loss of containment hazard consequence to worker is 3.

Event ID 1614700/512 (SRD Page 5-299)

HVAC event consequence to worker is 3.

Event ID 3200/1199(SRD Page A-170)
Exposure to toxic feed materials event consequence to worker is 3.

Event ID 1614667/135 (SRD Page 5-102)
Nitric acid handling operation event consequence to worker is 3.

Description

Why were the 3 and 4 PHA scenarios not listed in the ISAR?

Contractor Response

As stated in section 4.7.1.1 of the ISAR, "Sorting of High Consequence Events,"

"Only those events with potentially high consequences to the public or the co-located worker were considered for further scenario development and analysis. Events judged to have serious or major consequences to the facility worker, but minor or negligible consequences to the co-located worker or the public, were not examined in this accident analysis. Instead, measures to protect the facility workers during events that are not regulated by normal occupational safety requirements are identified by the hazard analysis."

The full suite of PHA events was considered in screening the scenarios for those that warranted further consideration for the purpose of selecting bounding scenarios. As stated in the above paragraph, only those events considered to have potential effects outside the facility were considered for scenario analysis. Events with localized effects, e.g., Event ID 1614776/275, a fire that does not have the potential to spread contamination outside the facility, but that may have serious or major consequences to facility workers were identified from the PHA in a separate exercise. Those events provided the basis for developing controls for the protection of the facility worker.

Disposition The BNFL response is acceptable but subject to the following:

For the events that have high consequences to the worker, but minor or negligible consequences on the co-located worker or public, the BNFL did not pursue further in the accident analysis. BNFL states that hazards to the facility workers were identified from the PHA in a separate exercise. Worker protective measures were developed as a follow-up. The results of the worker associated hazard identification exercise and the development of worker protective measures will be reviewed by the regulators as part of the PSAR review.

Question # 95 **Status** Acceptable

Cited Submittal Text Section 4.1.4.1 - Surface Water

Cited Reference BNFL-5193-ISAR-01, Revision 0

Evaluation Criteria RL/REG-97-11, Revision 1, Section 6.1.4 - Site Description

Discussion The description of the Columbia River includes water flow figures that indicate a 40 percent flow increase from the point the river enters the Hanford Site to the point where it exists.

Description Please check the flow figures/explain the flow increase.

Contractor Response In the Part B PSAR, the referenced sentenced will be replaced with "The average flow of the Columbia River about 5 miles above the Hanford Site is approximately 3400 cubic meters/second (120,000 cubic feet/second)."

Disposition The BNFL response is acceptable

Question # 96 **Status** Acceptable

Cited Submittal Text Page 4-68 of ISAR Section 4.3, "Process Description" and on page 4-73, of ISAR Section 4.3.1.8, "LAW Glass Melter".

Cited Reference BNFL-5193-ISAR-01, Rev. O, TWRS-P Project Initial Safety Analysis Report. January 12, 1997.

Evaluation Criteria RL/REG-97-11, Guidance for the Review of TWRS Privatization Contractor Initial Safety Assessment Submittal Package, Section 6.1.2.3, "Process Description."

Discussion On page 4-68 of ISAR Section 4.3, "Process Description" is stated that the major difference between the HLW and the LAW melter is that the HLW melter receives solids-bearing waste, while an LAW melter receives only liquids. However, in Section 4.3.1.8, "LAW Glass Melter," it is further stated that the feed to the LAW melter is a slurry of the concentrated LAW from the evaporator and a blended mixture of glass-forming chemicals. It is understood that the rheology of the slurry-fed input feed will be one of the factors that will have to be considered due to the viscosity effects on the homogenization of the waste components. As such, there is a discrepancy in the process description that should be clarified by the contractor in order to better estimate the reliability of the process and to achieve the desired and optimum glass chemistry of the product.

Description Is it the contractor's intent that the LAW melter feed will be "only liquids?"

Contractor Response The distinction made in Section 4.3 addresses the waste composition. The LAW feed exists as a 10 M Na solution. While, the HLW consists of a slurry consisting of the sludge suspended in solution and radionuclides in solution. Both the LAW and HLW feeds are blended with glass formers prior to feed to the melter.

Disposition The BNFL response is acceptable

Question # 97 **Status** Acceptable

Cited Submittal Text ISAR Section 4.3.2 "Melter Offgas Treatment Systems," pp. 4-77 through 4-80.

Cited Reference BNFL-5193-ISAR-01, Rev. O, TWRS-P Project Initial Safety Analysis Report. January 12, 1997.

Evaluation Criteria : RL/REG-97-11, Guidance for the Review of TWRS Privatization Contractor Initial Safety Assessment Submittal Package, Section 6.1.2.3, "Process Description."

Discussion It appears that the ISAR has not corrected an apparent error that was brought up while reviewing the SRD. In the HAR Section5.2.12, "LAW Vitrification Offgas Treatment and Emergency Offgas Treatment Systems," on page 5-171, there appears to be a discrepancy between the melter pressures listed under pressure control (10 mbarg) and the melter pressures listed under the emergency offgas system (-5 mbarg). The Contractor should clarify, and include a more detailed explanation of how the melter pressure triggers the system

It is the reviewers' conclusion, based on experience, that the correct description is in the final paragraph of Pg. 5-171 of the HAR, i.e., the melter is normally maintained at -5-mbarg pressure. The 10-mbarg value stated in the second paragraph at the top of the page probably was meant to refer to the normal downstream vacuum just behind the HEME.

Description What is the normal melter pressure value and at what value will the standby offgas treatment system begin operation?

Contractor Response The normal melter operating pressure will be approximately -12 mbarg (-5" w.g.).The standby offgas system will be activated if the melter pressure rises above about -1.2 mbarg (-0.5" w.g.) in order to avoid pressurizing the melter due to either loss or blockage of the normal offgas system or a greater than anticipated pressure surge in the melter. These pressure set points are preliminary based on initial conceptual design activities and will be further refined through detail design and testing activities undertaken during Part B.

Disposition The BNFL response is acceptable.

Question # 98 **Status** Acceptable

Cited Submittal Text Sections 1, 4.1, 4.2, and 4.3 of the ISAR.

Cited Reference BNFL-5193-ISAR-01, Sections 1, 4.1, 4.2, and 4.3

Evaluation Criteria RL/REG-97-11, Section 6.1.2, Design Description.

Discussion In ISAR Sections 1, 4.1, 4.2, and 4.3, facility and process design information is provided. Key unit operations include ion exchange (for cesium and technetium removal), scavenging precipitation (for strontium and TRU removal), several evaporation operations, vitrification steps, off-gas treatment, and decontamination. However, references and information supporting the design and efficacy of these operations are not included in either the ISAR or the Technical Report (Volumes I and II). Detailed process descriptions including material balances and experimental data is required to perform a review of the proposed processes. In particular, published, open literature data (e.g., ORNL/TM-13363, 13169, December 1997) exist that imply that the organic resins and CST may not function as anticipated; i.e., that potentially lower capacities and higher effluent concentrations may result. Also, the lack of an organic destruction step appears to contradict current Hanford experience with complexed concentrate waste (CCW) that shows that CCW contains organic chelating agents and that relatively few particulate solids are found under alkaline conditions in tanks containing CCW, implying that iron addition and additional alkalinity may not be effective. The effectiveness of these unit operations impact downstream operations, their design and safety, and may also result in materials not meeting contract specifications.

Description

Please provide documentation to support the selection of key processes including solid-liquid separations, scavenging operations, cesium and technetium ion exchange, evaporation, vitrification, off-gas treatment, and decontamination. This documentation should provide operational efficiencies and performance limits, experimental evidence to support the assumed performances, and plans to resolve technical uncertainties.

Contractor Response

Demonstration of the BNFL process for treating LAW and HLW feeds was conducted by personnel at IBC Advanced Technologies, Savannah River Technology Center (SRTC), and the Vitreous States Laboratory (VSL) at the Catholic University of America. Reports documenting these tests were provided to the U.S. Department of Energy (Dr. Neil Brown) as backup information for the BNFL Technical Report (BNFL-5193-TR-01) and the Waste Products and Secondary Wastes Plan (BNFL-5193-PSW-01). The Waste Products and Secondary Wastes Plan summarizes all test results and compares test results and engineering analyses with the requirements of the TWRS Privatization contract. Part B test plans are documented in Technical and Development Support to TWRS Design, K0104_077_PRC. Dr. Brown is coordinating the technical review of the BNFL process and facility. Please see Dr. Brown for copies of these documents.

BNFL did not conduct tests (nor was BNFL required to do so) during Part A to demonstrate the off-gas treatment and container decontamination systems. BNFL performed engineering analyses of these systems based on operating experiences and tests of similar systems.

Disposition

The BNFL response is acceptable.

Question # 99 **Status** Acceptable

Cited Submittal Text Section 4.3.1.6 of the ISAR.

Cited Reference BNFL-5193-ISAR-01, Sections 1, 4.1, 4.2, and 4.3

Evaluation Criteria RL/REG-97-11, Section 6.1.2, Design Description.

Discussion

The LAW treatment-only alternative uses crystalline silicotitanate (CST) as an inorganic ion exchange material (sorbent) and cesium waste form (see Section 4.3.1.6 on page 4-72 of the ISAR). Limited information is provided in the ISAR of the Technical Report concerning the use of CST. More description is needed to evaluate the overall safety of this operation.

Description

Please provide a better description of the CST loading operations including number of columns, amounts of CST and cesium per column, and anticipated column temperatures.

Contractor Response

A description of the cesium intermediate waste product and the process used to derive this product is provided in Section 3.2 of the Waste Products and Secondary Wastes Plan. The amount of CST per column (34.1 liters), the amount of cesium-137 per column (maximum of ~140, 380 curies), and other information for this intermediate waste product is provided in Section 3.2 of the Waste Products and Secondary Wastes Plan. BNFL has not finalized the number of CST ion exchange columns that would be connected in series during the loading operations. If awarded a contract for LAW only services, BNFL plans to conduct tests during Part B to determine the number of columns that are necessary for operations. Process flow diagram O_BE_1614662 presently depicts 10 columns (i.e., columns C2401 A through J) connected in series.

BNFL has not calculated the temperature of the CST column during operations or after loading. The TWRS Privatization contract does not state a temperature limit for the cesium intermediate waste product in specification 4.

Disposition

The BNFL response is acceptable.

Question # 100 **Status** Acceptable

Cited Submittal Text Section 4.3.1.6 of the ISAR.

Cited Reference BNFL-5193-ISAR-01.

Evaluation Criteria RL/REG-97-11, Section 6.1.2, Design Description.

Discussion The LAW treatment-only alternative uses crystalline silicotitanate (CST) as an inorganic ion exchange material (sorbent) and cesium waste form (see Section 4.3.1.6 on page 4-72 of the ISAR). Because essentially no information is provided on the drying and handling steps, even though it is critical to avoiding container overpressurization and radiolytic gas generation, an evaluation of the plant safety is impossible. Information on drying process, controls, procedures, and endpoints is necessary for a safety evaluation.

Description What measures will be taken to assure and verify that the cesium-loaded CST is properly dried and will not pressurize during storage? Please provide a better description of the CST drying and packaging operations including the drying temperature range, controls, procedures, and endpoints to verify that the containers will not pressurize during storage. The text should explain the monitoring and instrumentation to assure safe and proper control of the process.

Contractor Response A description of the cesium intermediate waste product, the drying process and the controls are provided in Section 3.2 of the Waste Products and Secondary Wastes Plan. Sections 3.2.2.3 and 3.2.2.4 of the Waste Products and Secondary Wastes Plan describe BNFL's method to ensure free liquids are not present and the cesium intermediate waste product is not capable of generating quantities of flammable or explosive gases. Planned methods to verify the cesium intermediate waste product does not contain free liquids and is not capable of generating quantities of flammable or explosive gases are discussed in Section 3.2.3 of the Waste Products and Secondary Wastes Plan.

Disposition The BNFL response is acceptable.

Question # 101 **Status** Acceptable

Cited Submittal Text Section 4.3.1.6 of the ISAR.

Cited Reference Initial Safety Analysis Report, BNFL-5193-ISAR-01

Evaluation Criteria RL/REG-97-11, Section 6.1.2, Design Description.

Discussion On page 4-72 of ISAR Section 4.3.1.6, "Cesium Recovery as a Solid," it is stated that air is used for the drying of the cesium-loaded CST. CST drying and storage are roughly analogous to the operations required in the dry storage of spent nuclear fuel and fuel pool debris; the latter operations use inert gases, for drying, and usually package the radioactive materials in helium because of its inertness and excellent heat transfer properties.

Description What gas will be used to backfill the loaded CST containers prior to sealing?

Contractor Response BNFL does not currently plan to use an inert gas to backfill the loaded CST containers. If awarded a Part B contract for LAW only services, BNFL will conduct tests to demonstrate compliance with contract specifications. These tests will determine if there is a need for an inert fill gas. Part B test plans are documented in Technical and Development Support to TWRS Design, K0104 077 PRC. A copy of this document was provided to Dr. Neil Brown for use by the RU.

Disposition The BNFL response is acceptable.

Question # 102 **Status** Unacceptable

Cited Submittal Text Section 4.3.2.3 of the ISAR.

Cited Reference BNFL-5193-ISAR-01.

Evaluation Criteria RL/REG-97-11, Section 6.1.2, Design Description.

Discussion

In the ISAR, the Technical Report, and the HAR, it has been stated that the dry absorption unit reportedly removes 98 percent of the iodine gas containing iodine-129 from the HLW melter offgas. Further information should be provided in regard to the ability of the remainder of the offgas system to remove the residual iodine-129.

Description

Please provide mass balance information for removal of iodine-129 from each HLW offgas unit operation and the anticipated iodine-129 release rates from the plant.

Contractor Response

From "TWRS Mass, Activity, and Heat Balance Assumptions Document;" K0104_REP_015_PRC, the removal of Iodine in the off gas system is listed below.

HLW Melter & Melter Off Gas Equipment	Decontamination Factor
Melter	1
HEME	1
HEMF	1
Iodine Absorber	50
HLW off gas condenser	2
HLW Wet Scrubber	3
Common LAW and HLW Scrubber	3

Disposition

The BNFL response is unacceptable for the following reason:

The BNFL response is incomplete. The question asked for iodine-129 removal efficiencies and plant release rates of iodine-129. The response only gave removal efficiencies. Iodine-129 release rates will be determined in the future.

Question # 103 **Status** Unacceptable

Cited Submittal Text Section 4.7.2.4.5 of the ISAR.

Cited Reference BNFL-5193-ISAR-01.

Evaluation Criteria RL/REG-97-11, Section 6.1.2, Design Description.

Discussion

In Section 4.7.2.4.5 of the ISAR, "Boiling of Technetium/Cesium Product Storage Tank," the contractor states that because of the estimated time to boil, it is reasonable to expect that the loss of cooling would be detected and cooling restored. Before a conclusion can be reached that no DC II mitigative features are required, the pertinent design features that would provide defense-in-depth for both detection and restoration of cooling should to be identified.

Description

What are the features and associated design classes of the cesium storage tank cooling system that would allow a loss of coolant to be detected and cooling restored as stated in Section 4.7.2.4.5 of the ISAR?

Contractor Response

The heat transfer analysis of the Tank 2710 to date has shown that it is not credible for a boiling event to lead to the need for Important to Safety equipment. As such, no SSCs associated with the tank have been identified as Important to Safety. The analysis in Section 4.7.2.4.5 describes the event. This indicates that boiling will be minimal and lead, at worst, to an extremely small evolution of radioactive materials. For a no heat loss (adiabatic) analysis, the analysis showed 5 days were required to reach boiling. The corresponding analysis with heat loss to the surrounding cell walls showed an equilibrium temperature of about 106 °C is reached in about 11 days.

Disposition

The BNFL response is unacceptable for the following reason:

The response did not address the question. The response states that the approach is conservative such that the radionuclide release rate (i.e. boiling rate) will be smaller than estimated for the bounding case in the ISA (24 hours of boiling in the cesium storage tank). The response did not address the question concerning the ability to detect a failure of the cooling water system and the ability to return cooling water to the system so that the duration of the release will be minimized. If the loss of cooling cannot be detected or the cooling water cannot be restored, the release will go on for longer than 24 hours and the entire tank contents could be released. If the assumed release rate is overly conservative, this should have been fixed in the ISA. The conservatism in the release rate cannot be used to justify the lack of need for detection and remediation equipment. This matter will be pursued during future interactions between the RU and BNFL.

Question # 104 **Status** Acceptable

Cited Submittal Text Section 4.7.1.2.3 of the ISAR.

Cited Reference Initial Safety Analysis Report, BNFL-5193-ISAR-01.

Evaluation Criteria RL/REG-97-11, Section 6.3, Hazards Assessment and Control

Discussion The potential for ammonium nitrate precipitation on filters (ISAR pages 4-136 and 4-137) is dismissed as a valid accident without evaluation because of previous analyses at other (different) facilities. Later in the ISAR, Event 34 (page 4-140) postulates that loss of control of the SCR could result in ammonium nitrate formation and explosion of the SCR. Without further explanation, these two statements appear to contradict each other. If ammonium nitrate can form in the SCR, it could also be transported downstream where it could settle on the HEPA filter causing a fire or explosion.

Description Why is ammonium nitrate formation, deposition on HEPA filters, and subsequent combustion dismissed in Section 4.7.1.2.3 of the HAR when Event 34 on page 4-140 specifically states that loss of control of the SCR temperature could result in ammonium nitrate formation and explosion?

Contractor Response Investigation of the potential for ammonium nitrate precipitation and subsequent energetic reaction, either fire or explosion, during transfer and pretreatment of the wastes was recorded as an action item (0/1/10) during the PHA. The primary concern was dissolved ammonia in the waste providing the source for ammonium nitrate formation. The resolution of this action stated the following:

"The hazard analysis for the TWRS FSAR dismissed ammonium nitrate as a fire or explosion hazard based on studies that arrived at the following conclusions:

1) The high alkaline nature of the waste does not support the precipitation of ammonium nitrate from the waste. Ammonium ion in solution is orders of magnitude lower than needed for precipitation, the equilibrium is toward ammonia dissolved in the supernate and slowly released as a vapor.

2) A vapor phase reaction between ammonia and nitrogen dioxide could lead to formation of ammonium nitrate that could precipitate on HEPA filters, in ventilation ductwork and fans. Measured concentrations of nitrogen dioxide in tank vapor space gases are much lower than required to produce sufficient ammonium nitrate to completely plug a HEPA filter in a year.

3) An appropriate combination of temperature, confinement, quantity, purity, and initiators is required to induce a rapid exothermic reaction involving ammonium nitrate. Such conditions are not present in any of the Hanford waste tanks. A confined charge requires a temperature of 260 to 300 °C (under a pressure of 2500 psi) to explode. The material, if pure, will burn at a temperature of 500 °C. A completely plugged HEPA filter has been estimated to contain at least a factor of 30 less ammonium nitrate than required to sustain a detonation.

References:

Pederson, L. R., and S. A. Bryan, 1994, Assessment of the Potential for Ammonium Nitrate Formation and Reaction in Tank 241-SY-101, PNL-10067, Pacific Northwest Laboratory, Richland, WA 99352

Borscheim, G. L., and N. W. Kirch, 1991, Summary of Single-Shell Tank Waste Stability, Westinghouse Hanford Company, Richland, WA 99352"

This action item resolution was the basis for eliminating the potential for ammonium nitrate as a fuel to support the potential for HEPA filter fires as discussed on pp. 4-136 and 4-137 of the ISAR.

PHA event number 34 specifically addressed the potential for ammonium nitrate formation from the anhydrous ammonia supplied to the SCR. The process description for the SCR unit in Section 5.2.12 of the BNFL TWRS-P Hazard Analysis Report indicates that ammonium nitrate may form if the temperature of the offgas stream entering the SCR falls below 200 °C. However, item 3 of the action item resolution quoted above provides some justification for assuming that the potential for a fire or explosion from ammonium nitrate accumulated on the filter is low. Therefore, the discussion of ammonia or ammonium nitrate fire or explosion on page 4-140 of the ISAR focuses on accumulation of these materials in the SCR catalyst bed rather than on the HEPA filter

Disposition

The BNFL response is acceptable but subject to the following:

The response by BNFL is not entirely convincing but acceptable for this stage of design. Due to the serious consequences of a mis-analysis, these issues will be reviewed again in Part B when the system design and associated processes are developed in more detail.

Question # 105 **Status** Acceptable

Cited Submittal Text Section 4.7.1.2.4 (pg. 4-139) of the ISAR.

Cited Reference BNFL-5193-ISAR-01.

Evaluation Criteria RL/REG-97-11, Section 6.3, Hazards Assessment and Control

Discussion

Events 24 and 26 postulate that explosions in the HLW melter system dislodge and disperse radioactivity that has accumulated in the melter plenum and offgas system. The maximum source term is assumed to be 69.8 grams of material that has accumulated on the HEPA filter. This mass of material is conservatively assumed to be all cesium. This analysis ignores the much larger source of dispersible material that will be deposited in the offgas pipe between the melter and the venturi scrubber. The material in the offgas line could be several kilograms of alkali borates that are rich in cesium and HLW solids. This source would likely dwarf the amount of material on the HEPA filter. The source term should for the melter explosion should be re-evaluated and compared to the bounding case (resin degradation) chosen for the explosion scenario. The source term from the offgas pipe may be larger than the resin degradation source term that bounded the explosion scenario.

Description

Why was the HEPA filter solids chosen as the source term for Events 24 and 26 instead of the accumulated cesium and HLW solids in the offgas pipe between the HLW melter and the venturi scrubber?

Contractor Response

The offgas film cooler is designed to minimize deposition of solids in the line between the HLW melter and the venturi scrubber. The effectiveness of the design is to be tested and the maximum deposition rate estimated. At the present stage of design, there are insufficient design and process data to estimate a bounding value for radionuclide deposition in the line. However, it is reasonable to expect that the design of the film cooler (to minimize deposition) will effectively prevent buildup that would exceed the source term for the ion exchange resin degradation scenario. The potential for a melter offgas system explosion, and the material at risk for release from it, will be considered again during the Part B HAZOP and PSAR accident analysis process.

Disposition

The BNFL response is acceptable but subject to the following:

The response is acceptable in that BNFL committed to evaluate this issue during Part B HAZOP and PSAR accident analysis. Information in existing literature suggests that the concern has not been evaluated adequately.

Question # 106 **Status** Unacceptable

Cited Submittal Text Section 4.7.2.1.2 (page 4-149) Source Term Analysis, Table 4-35

Cited Reference BNFL-5193-ISAR-01, Revision 0

Evaluation Criteria RL/REG-97-11, Revision 1, Section 6.5 - Analysis of Design Basis Events

Discussion

The approach used to obtain the radionuclide composition of the TRU in Envelope B waste from the contract specification (Table TS-7.2) is unclear. Also, daughter radionuclides (ex Y-90 which is a daughter of Sr-90) are apparently not included in the Envelope B waste and in the accident analysis although the contract states that they should be considered.

Description

1. Explain the approach used to obtain the radionuclide composition of TRU in the Envelope B waste.
2. Discuss whether daughter radionuclides are included in the accident analysis.
3. If not, explain the basis for not including these nuclides.

Contractor Response

1. The contract specification gives the TRU composition of Envelope B waste as 6.0 x E+05 Bq per mole sodium. Assuming a 7M sodium solution, this gives 4.2 x E+06 Bq TRU/L Envelope B solution. Based on early work by BNFL Engineering, Limited, it was assumed that the TRU content was proportioned amongst Am-241, Pu-239, and Pu-240, with 95% of the total TRU activity assumed to be from Am-241, with Pu-239 and Pu-240 equally responsible for the remaining 5% of the TRU activity. Assuming the high percentage of TRU activity to be due to Am-241 provides conservatism in the results because the inhalation dose conversion factor for that isotope is the highest for any of the TRU isotopes.

2. The decay daughters were considered in developing the source terms for the accident analysis. The dose effects from Cs-137 include the effect of its very short-lived Ba-137m daughter. Therefore, the 137Cs/137mBa pair was treated as a single isotope in the analysis. For the Envelope D waste, equilibrium values of other pairs, like Ru-106/Rh-106 and Sr-99/Y-90 are listed in Table TS-8.3 of the contract specification. All the values in the contract specification for Envelope D waste were entered into an initial calculation of the Envelope D inhalation dose per unit waste (given in Table 4-38 of the ISAR as the unit liter dose). It was determined that the radionuclides listed in Table 4-38 contributed 99.5% of the dose. Therefore, the others radionuclides in Table TS-8.3 were not carried through the analysis.

For the Envelope B waste, it was assumed that Y-90 was in equilibrium with its parent. It was found to contribute less than 0.02% of the total inhalation dose. Therefore it was removed from further consideration.

Disposition

The BNFL response is unacceptable for the following reason:

It is not clear why it necessary to make assumptions on TRU composition in lieu of using actual measured data from the tank farms. Measurements should be available that provide the basis for TRU composition for all waste envelopes.